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THE IDEALS OF A SOIL SURVEY.

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A NATIONAL soil survey is a method of classifying lands into groups and types in a manner which designs to express the relationship of one soil to another, and to indicate the relative value of each. One of the last stages of such a work is the demarking of boundaries of soil types in the form of a soil map. A soil survey therefore seeks to classify land with regard to its quality and usually takes place in settled country, while a land survey deals chiefly with the position of land and usually takes place in virgin country. A topographical survey is a land survey on a larger scale, giving details of surface contour, and showing the chief improvements effected by settlement, such as roads, bridges, and buildings.

The United States Department of Agriculture has among its several organizations a Bureau of Soils, which is charged with the duty of carrying out a soil survey of the American Union. In a little work issued by the Bureau the purpose of a soil survey is described as "to map, classify, correlate soils, to determine their field characteristics, to report on the actual use being made of the soils and on their adaptations to various crops so far as can be determined, and upon the relative productiveness of the several soil types." The Bureau

points out (1914) the value of such knowledge to the following classes of people: (1) Scientific men engaged in the investigation of problems relating to plant-production, to farm-management, to farm demonstration, to stock-raising, to problems of rural organization, to road-building—in short, to many branches of agricultural science; (2) the farmer; (3) colonists, colonization agencies, investors, development organizations, and individuals; (4) students of geographic, social, and economic sciences without reference to agricultural industries.

In the 1922 report of the United States Secretary of Agriculture it is stated (page 392) that the soil-survey work is the basis for the experimentation of the various State agricultural experiment stations. As a result of this classification of the soils varietal and fertilizer tests are being established on the large and important soil types of the United States. That the soil type possesses individual characteristics is becoming more and more recognized by the agriculturist, county farm adviser, and extension-service director. The peculiarities of the various soils must be considered if we are to make the greatest progress in plant breeding and selection, in fertilizer practice, in cultivation—in fact, in all work looking to improvement of cultivated crops.

THE BASIS OF CLASSIFICATION.

Every branch of natural science is dependent on some classification of the elements with which it deals before much progress may be made. In chemistry the discovery of the periodic law provided a scheme of classification into which all the known elements could be placed, and in which any future discoveries could be fitted. In botany and zoology schemes of classification based on the natural relationship of plants and animals have been indispensable to the study of those sciences, and in geology a classification based on the age of the rocks has been necessary. So, with soil science—at present in its infancy—it is equally necessary that some scheme of classification should be adopted.

The character which both the British and American authorities are agreed upon accepting as the key to the classification of soils is the size of the particles, and the proportion of the differently sized particles which make up a soil. Hall and Russell, the Rothamsted agricultural chemists, recommend that for the purpose of a survey a large number of soils should be submitted to mechanical analysis, including the determination of the organic matter and of calcium carbonate, and that then a carefully chosen representative set should be analysed chemically so as to characterize the type; these can further serve as standards with which farmers' samples can be compared by the citric-acid method of determining available plant-food. These English authorities agree with Whitney (Chief of the United States Bureau of Soils) that mechanical analysis should form the basis of the survey, because it alone takes into account those physical functions—the regulation of the water-supply and therefore of the temperature, of the air-supply, and of ease of cultivation, &c.—that play so large a part in determining the value of a soil. This method of classification is, however, not applicable either to chalk

(limestone) or to organic soils. These exceptions occur so rarely that no difficulty will be encountered in New Zealand in adopting soil-texture as a basis of classification.

Soil-texture in all but humus soils is governed by the size of the inorganic (mineral) particles composing the soil. The nomenclature of these particles is framed on words in common use, but it must be remembered that in soil science they have a definite meaning, and that each term refers to particles of a size varying within definite limits. The coarsest of these particles is termed gravel, and the other sizes are, in the descending order, called sand, silt, and clay. The first three are further subdivided into fine and coarse fractions. These terms are sufficiently explanatory to enable one to denote the method of allotting a name to any given soil. That sized fraction which is present in greatest amount gives its name to the soil, and those fractions which are present in still large amounts but less than the largest give (where present) their name as a qualifying adjective. Thus a soil may be called a fine sandy clay, gravelly sand, or a sandy silt. When only one fraction predominates it is, of course, necessary to use only a simple term to describe it. The dune-sands of the coast are therefore merely "sands." This may seem so obvious as not to need the telling, but it is necessary to caution readers that although the terminology of soils is commonplace it is not loosely used. A "sandy silt" not only means that the soil is composed of particles of definite size (within certain limits) to which the words "sand" and "silt" have been allotted, but that the silt predominates in quantity over the sand, and that both occur in the proportions to which that compound name has been allotted. The determination of the proportion in which the differently-sized particles occur is the somewhat lengthy operation of the chemical laboratory known as mechanical analysis or physical analysis.

In the United States it is the practice to prefix a locality-name to the soil-name, indicating the type thus—for example, "Orangeburg fine sand" and "Susquehanna clay."

MAPPING OF SOILS.

Having shown how soils are classified it is necessary to show how their distribution is put on record. This may be done in various ways, but the best is by means of a soil map indicating by various colours the sites of the different types. The presence of certain types sometimes may be inferred by the system of plant-indicators. This method is based on the fact that in some countries certain plants are characteristic of certain soil types and are not found elsewhere in the same abundance or luxuriance. Hence the vegetation is in some cases a guide to the soil. Minerals—mica or calcic carbonate, for instance—occasionally may be used as indicators. Lastly, when the parent rock from which the soil was derived is known the soil may be indicated by that means.

A soil survey may be one of three kinds :—

(1.) A flying soil survey, which aims at making a rapid examination of the soils of a district with a view to discover the main types which occur, and to describe them. This method is suited to country in the virgin state and when covered by virgin vegetation. An example is

the writer's survey of the Auckland Islands (1907), in which it was found possible to correlate the main types of soil with reference to the natural vegetation (see this *Journal* for January, 1911).

(2.) A reconnaissance soil survey, which is a more careful examination with a view to a detailed survey later.

(3.) A detailed survey, which can only be undertaken with the aid of a good base map on a scale sufficient to show the situation and extent of each type when the area is mapped.

Accurate mapping is not attempted in the first two kinds of survey. In these it is sufficient to give such information, be it of topography, appearance of soil, or plant covering, which will enable the man on the land to recognize the soil types by mere description. In the detailed survey the farmer is not put to the trouble of identifying soil types from description, but only has to identify the position of his soil on the map.

In the United States the soil surveyor is provided with a base map of one-mile-to-the-inch scale. Each section or square mile is divided into 40-acre plots on the map, and the surveyor must inspect every 10 acres and determine the type or types of soil composing the section. The different types are indicated on the map in different colours. The samples are drawn for inspection, and, if necessary, for analysis, by means of an auger which may be lengthened to reach subsoil depths. A method of checking the accuracy of the work in the field is for two men to operate on adjoining strips of land, and if the work is done correctly the soil-type boundaries will correspond on the line between the strips.

The largest unit used in classifying the lands of the United States is the soil province, which is subdivided into the soil series, which are again divided into the smallest unit, the soil type.

The soil province is a large area of country, not necessarily massed together as the word "province" might seem to imply, but of odd shape, often straggling over huge areas of territory or existing even in disconnected stretches or patches of country. The soil provinces of the United States are some fourteen in number, and owe their individuality to varying causes, some being defined from geographical position, some on geological, and some on climatic grounds. Thus the flood-plains of the great rivers flowing into the Gulf of Mexico are a soil province, the glacial lake and river terraces are another, the limestone uplands and valleys are a third, the Rocky Mountains and plains are a fourth, the arid South-west a fifth, and so on.

EXAMPLES OF AMERICAN AND EUROPEAN PRACTICE.

When the soils of a province have a common origin, differing only in texture, and are alike in colour and physical properties other than those affected by texture, this collection of soils is termed a soil series, and these are arranged, according to texture, into soil types. Thus in the glacial and loessal* soil province, which includes the State

*Loessal material means material deposited by wind.

of New York, we have the Miami series, which comprises fourteen types of soil, ranging from Miami stony sand (the coarsest texture, of which there are 100,000 acres) down to the Miami clay loam (the finest texture, of which there are nearly 2,000,000 acres).

We learn that the Miami series is one of the most widely distributed and complete soil series that has been established. The series is characterized by the light colour of the surface soils, by derivation from glacial material, or by being timbered, either now or originally. The heavier members of the series are better adapted to wheat than the corresponding members of the Marshall series, but they do not produce as large yields of maize. The clay loam is the most important for general farming, and forms the principal type of soil in western Ohio and central and eastern Indiana. It is especially well adapted to small grain and grass crops. The silt loam is more rolling and hilly than the clay loam, and is not so well suited to general farming. Wheat does better upon it than upon the Marshall silt loam, with which it is closely associated, but the yields of maize are considerably less. It is also well adapted to fruit, especially apples. The sandy loam and fine sandy loam are used for general agriculture, but are especially adapted to medium and late market-garden crops and fruit. The loam is suited to maize and potatoes, while small grain and grass are grown, but with less success than upon the clay loam. Strawberries and raspberries, as well as other small-fruits, do well on this type. The stony sand, gravelly sand, and gravel are not of much agricultural value under present conditions. The stony loam is a good general-farming soil, is also well adapted to apples, and furnishes excellent pasture, while in New York lucerne is grown upon it very successfully. The stony sandy loam and gravelly sandy loam are not strong soils, but are fairly well suited to light farming, fruit, and market-garden crops. The sand and fine sand are not adapted to general farming, but are the best early market-garden soils of this section. Such is a brief example of an American soil survey and its application in a most closely settled rural area.

Sir A. D. Hall considers that only by comparison with the type soil can the analysis of any particular soil be interpreted. The fact that a soil from a given arable field contains 0·15 per cent. of phosphoric acid takes a very different aspect when it is known that the soils of the same type contain as a rule 0·18 to 0·20 per cent., particularly if also the response of that kind of land is known by field trials or from the accumulated experience of farmers.

The importance of a soil survey in an old and closely settled country like England is different from that in a comparatively new country like the United States or New Zealand. The importance in the older country is largely in its application to the saving of the manure bills of farmers by their adoption of more efficient fertilizers. "By having the requirements of their land made known to them, enormous economies might," says the last-quoted authority, "be effected in the bills of almost every farmer using artificial manures, if the latter were properly adapted to his soils and crops." He concludes that it is not too much to say that the information as to manuring which is being accumulated at

many experimental centres throughout the country can only be rendered properly available by the execution of a soil survey in the district under consideration.

The United States stands foremost in the extent of its soil-survey activities, but in some other countries, notably Prussia, Belgium, and France, soil survey is by no means neglected. A beautiful example of the latter country's work is copied into the *Journal of the Ministry of Agriculture* (England) for April, 1920, page 57. The map is roughly on a sixth-of-a-mile-to-the-inch scale. The different geological formations are shown in different colours, and on each is inserted a parti-coloured disk-shaped portion, the colours of which correspond to the legends "organic matter," "chalk," "clay," and "sand," while the size of each colour corresponds to the proportions of those ingredients present in the soil. Another figure of rectangular shape gives at a glance the proportion, expressed as parts per thousand in the soil, of nitrogen, phosphoric acid, potash, and lime. In this map, indicating about four square miles, there are depicted four geological formations, and on them are indicated the results of eight mechanical analyses and thirty chemical analyses.

A NEW ZEALAND ILLUSTRATION, AND THE MATTER OF COST.

Applying the American method of soil survey to the lands of our Manawatu coastal area, as a hypothetical illustration, we might have —(1) The Tararua series, consisting of the soil types—gravels, river-sands, loams, and clays—derived from the greywacke rock of the Tararua Range, and combinations of these; (2) the littoral series, consisting of the dune-sands of the coastal plain, and combinations with various amounts of organic matter; (3) the Manawatu series, consisting of the clays and silts of the Manawatu River flood-plain, and combinations of these with organic matter; (4) the Otaki series, consisting of the terrace lands overlying the old Otaki sandstone; (5) the organic series, consisting of those swamp soils the peaty nature of which has dominated all other constituents.

All the rivers between Paekakariki and the Manawatu River, having their sources in the Tararua Range, would therefore deposit mainly the Tararua series of sediments, but the Manawatu River, drawing its suspended material from many other sources, and the material differing largely in nature, warrants the allotment of a different soil-series name to its flood-plain.

The foregoing is a very rough sketch of a basis for classifying the Manawatu lands. The writer has endeavoured to place the series in the order of their relative importance. In mapping the country the difficulty will be to define the boundaries where one type by admixture imperceptibly shades off into another type. The mechanical analysis has always been used by this Department in classifying soils, and was so used in the Manawatu soil investigations (see *Journal*, Vols. xx and xxi).

In 1905 more than 20,000 square miles had been surveyed by the United States Bureau of Soils, with the aid of forty-five assistants,

at an average cost of $2\frac{1}{4}$ dollars per square mile, not including travelling-expenses. Later costs have been quoted by the same organization at 4 dollars per square mile. Still later no mention is made of the cost. Apparently the value of the work has established itself in the minds of the farmers, and the expense is no longer of interest to them. It is not likely that a detailed soil survey of New Zealand lands could be made at anything like the cost per unit of area to the United States, whatever it may be at present. In that immense country very large areas occur having a uniform soil origin and structure. The average cost of surveying such a country per square mile must always be small compared with that for comparatively small islands like New Zealand, where change of soil type is frequent, large-scale maps non-existent, and the surface extremely variable.

CONCLUSION.

The writer's opinion is that for New Zealand a complete soil survey will come in time, but that much good can be done in the meantime by means of a reconnaissance survey by which one may gain a knowledge of all the types existing, and may describe without being able to map them. By such means a soil survey may be begun, and the descriptions of types should be intelligible to the local scientific officers of the Department. Although it might not be possible for them to delimit the boundaries of types, and say just where one soil ends and another begins, it should be possible in typical cases to recognize types. At present, except in pressing cases, the detailed soil survey of New Zealand will be made to coincide with the topographical survey which the Lands Department is executing. Approval has been given to the resumption of the North Island reconnaissance soil survey interrupted by the war and since delayed for financial reasons.

No systematic soil survey has been undertaken of the soils of Great Britain, but several most readable treatises have been published on the soils of certain districts. Chief among these is Sir A. D. Hall and Sir John Russell's delightful "Agriculture of Soils of Kent, Surrey, and Sussex" (1911). Others are G. W. Robinson's "Survey of the Soils and Agriculture of Shropshire" (1912); Dr. Luxmore's "Soils of Dorset"; Goodwin's "Soils of Nottinghamshire"; L. F. Newman's "Soils and Agriculture of Norfolk"; and lastly the memoir of Mr. T. H. Rigg (formerly of this Laboratory and now of the Cawthron Institute, Nelson) on "The Soils and Crops of the Market-garden District of Biggleswade" (1916). The first two named of these surveyors take a most comprehensive view of their duties, and produce works of value to the historian and rural economist. In the American publications we miss those milestones on the road which a race creeps by to greatness. To quote a few lines from Robinson: "In Shropshire, at the time of Domesday, land had a mean annual value of about 2d. per acre. A horse was worth something of the order of 10s., an ox 30d., a cow 20d., and a slave £1. There were about 25,000 slaves in Shropshire who had no legal rights whatever."

It is to be hoped that when New Zealand soil surveys come to be written they may be as true a record of rural history and craft as those to which the British authors have set their names.

THE GRASSLANDS OF NEW ZEALAND.

SERIES II. THE TARANAKI BACK-COUNTRY.

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1. FOREST SUCCESSIONS.

THE hill country of New Zealand that has been cleared of forest or that still carries forest has been neglected too much in the past from a grassland-research point of view. Millions of acres of forest have been felled and grassed more or less haphazardly. Those areas which could be stumped and ploughed are among the richest of our grassland areas, but of the unploughable forest lands, out of 11,000,000 acres felled and surface-sown with grass, nearly 4,000,000 acres have reverted to scrub and fern, and this state of reversion is by no means stationary, 500,000 acres having been added to the total, according to official statistics, during the past four years. When it is thus remembered that every year during the past four years some 125,000 acres of our hill country have gone back to secondary growth it will be realized that money spent on research work on that country is amply justified. Every acre of such country that reverts to secondary growth means an average expenditure of fully £2 per acre to clean up and resow, making for each year an expenditure by the hill-country farmers of, say, £250,000 if the deterioration is to be stayed.

The writer hopes to be able to prosecute research more and more closely on our hill country generally, and operations have already been begun in the Whangamomona County. This work is being carried out in co-operation with Mr. J. W. Deem, chief Fields Division officer for the district, and with the assistance of Mr. A. J. Glasson, Fields Instructor in Taranaki. As the work proceeds, the results will be recorded from time to time in the *Journal*, and it is intended that the present article shall be the first of a series appertaining to the country in question.

The Taranaki back-country is decidedly hilly. Geologically speaking, the country is of recent origin, raised up as a great plain from the ocean depths. Upon the surface of this upraised plain nature has plied with its tools—rain, frost, and running water—and has sculptured out the present land-form. The streams cutting down have left the ground unevenly raised, in some places as small or large hillocks, and in other places as hills ranging in varying heights up to 500 ft. or 600 ft. Some of the hills are extremely steep, meeting at the base in narrow V-shaped ravines; others are more gently sloping, often with intervening valleys aggraded so that small areas of flat are formed between the slopes. The hills themselves vary from being bluntly or sharply razorback to easy rolling convex surfaces. From any point of the highest ridges—1,300 ft. above sea-level—the country looks like a billowy sea as hill after hill rises in wave-like regularity, lighted and shaded according to its disposition to the sun. The whole land-form—hills of various

FIG. 1. THE HILL COMPLEX, SHOWING SOME CHARACTERISTIC FEATURES.

In the background are bluntly razorback ridges with rather easy sloping foothills. The foreground is exceedingly steep; the stumps seen are mainly those of kamahi; the standing dead tree on the left is totara.

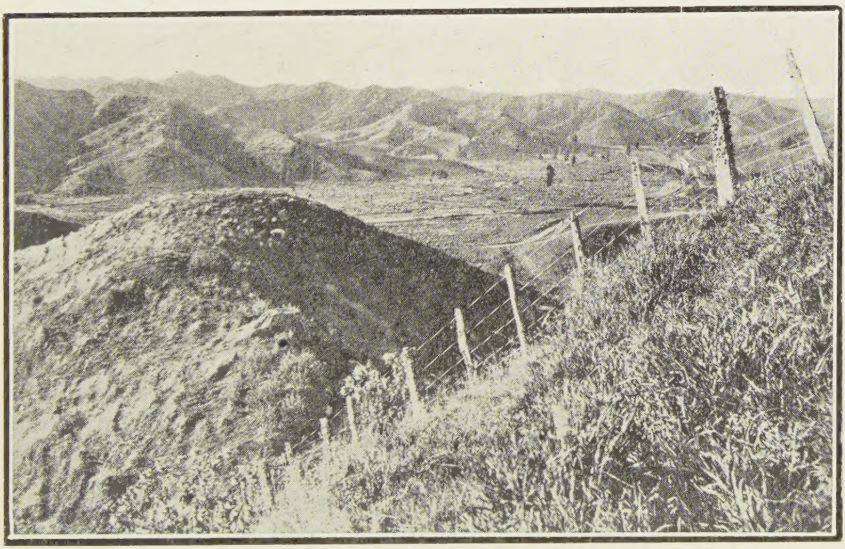

FIG. 2. ANOTHER VIEW OF THE HILL COMPLEX.

Showing in the foreground a steep well-grassed ridge and easy sloping hillock; in the middle distance is an aggraded flat; and beyond, the steeper and more rugged country.

[*Photos by E. B. Levy.*

heights and shapes, with the intervening ravines and small aggraded flats—we may call the "hill complex" (Figs. 1 and 2).

The surface soil is a light, friable, chocolate-coloured loam; the subsoil is either sandstone or blue papa. The sandstone formation may often be seen lying on top of the papa at the junctions of the two great subsoil formations. Here often a layer of sandstone alternates with a layer of blue papa, telling the geologist in his own language of oscillations of the sea-floor prior to the uplift which decided that thenceforth only sandstone would be deposited instead of the deep-sea deposit of blue papa. In the two subsoil formations, but more particularly in the sandstone, pockets or seams of a fairly hard pebble-and-shell conglomerate occur. This "shell rock" is quarried and used as road-metal.

The two classes of subsoil are held by the local farmers to have quite different agricultural possibilities, that of blue papa being considered superior in quality to the sandstone. Nature, in the great forests it has produced on these classes of soil, has differentiated scarcely at all between the two. The forest cover is, in the main, similar throughout both formations.

TYPES OF FOREST.

In view of the fact that the forest is a valuable index in deciding which grasses and clovers are the most likely to be successful in the establishment of grassland on these soils, a short description of the forest, particularly from the point of view of the disposition of its species in regard to the various aspects of the country, will be of considerable value. Tawa is essentially the dominant primary-forest tree (Fig. 3). If we start from the small flats and gradually rise up to the highest ridges we pass through a sequence of forest-growth. On the small aggraded flats between the slopes (Fig. 2) kahikatea (*Podocarpus dacrydioides*), rimu (*Dacrydium cupressinum*), and pukatea (*Laurelia novae-zealandiae*) predominate; but as the ground begins to rise, so tawa (*Beilschmiedia tawa*) comes in, and on the lower levels and in the gullies it is associated with rimu, miro (*Podocarpus ferrugineus*), matai (*Podocarpus spicatus*), and maire (*Olea Cunninghamii*). The rimu, miro, matai, and maire become increasingly fewer as we ascend, and almost pure forests of tawa are met with a short way up the slope. Within the rimu, miro, matai, maire, and tawa forests tree-ferns are abundant, particularly the weki (*Dicksonia squarrosa*) and hemitelia (*Hemitelia Smithii*); and in the drier parts the mamaku (*Cyathea medullaris*) rises gracefully through an opening in the forest-roof. Within these forests also the floor is, in the main, covered with terrestrial ferns. Weki extends well up into the tawa forest, but here the general forest-floor is more or less free of ferns or other growth, with the exception of the graceful single crape fern (*Leptopteris hymenophylloides*), which may be abundant.

As we climb higher up the slopes and get on to the poorer and higher ridges the tawa becomes intermingled with kamahi (*Weinmannia racemosa*), hinau (*Eloeocarpus dentatus*), rewarewa (*Knightia excelsa*), rata (*Metrosideros robusta*), and totara (*Podocarpus totara*); then higher up still, on the poorest and driest ridges and knolls, the tawa almost disappears, and black-beech (*Nothofagus Solandri*) there

FIG. 3. THE PRIMARY FOREST.

Tawa is dominant, but associated with it in minor associations are kamahi, rewarewa, hinau, miro, maire, and rimu. The tall tree in the foreground to the left is rimu.

FIG. 4. SHOWING PRIMARY AND SECONDARY FOREST.

Primary forest (in background) on steep, poor ridge—rewarewa, tawa, kamahi, hinau, rata, black-beech. Secondary forest in foreground—tutu, tupari, wineberry, tree-fuchsia, odd manuka, kamahi, tingahere, and karamu.

[*Photos by E. B. Levy.*

predominates (Fig. 4). These groups, then, comprise essentially the primary forest, and they are of immense significance, as will appear later, in deciding the varieties of grasses and clovers that should be sown. The foregoing is an account strictly appertaining to the ancient forests, which are here termed the "primary forest."

Where there have been factors at work that have destroyed the primary forest within the last hundred years an altogether different growth has come into being, varying in its components and from the primary forest according to the longer or shorter time that has elapsed since that destruction, and according to soil and aspect. Such growth may be in the form of fern or scrub of different sorts, or it may consist of small trees. Both classes of growth must be regarded as developmental stages by which the primary forest may once more re-establish itself. To the fern and scrub may be applied the term "secondary scrub," and to the small tree associations that of "secondary forest." The primary forest is really the aged adult; the secondary scrub and the secondary forest are but phases in the life-cycle or processes of growth leading to the adult primary forest. Here, then, we find in natural vegetation, as in our grasslands, that there is succession—that is to say, there is a series of plant communities, one type by its growth preparing the way for the next, which when established will replace its foster parent. The latter in its turn will grow—it will again modify the conditions so that a still higher class of forest-growth may establish, and this, too, will ultimately be replaced by a still higher forest-form. And so the succession of forest types goes on until finally there arises an association that ceases to change. This stage is old age; it is the climax of a gradual development. It is called a "climax association." Development, of course, never stops in nature, but the change after a shorter or longer time becomes so slow that for all intents and purposes the scenes have ceased to change.

Actually it would appear that in the Whangamomona district there were only two climax trees—tawa on the slopes and kahikatea on the wetter flats. On the slopes, then, all the other primary-forest trees present would be looked upon as preparing the way for the tawa climax, and we could tentatively arrange them in the following order of development: Black-beech, totara, kamahi, rewarewa, hinau, maire, rimu, rata, tawa. The present disposition of the trees as they appear in the primary forest supports this order of development. Where there are old and often knarled totara, black-beech, rewarewa, &c., we find the undergrowth not to be young trees of these species (though some young rewarewa may establish there), but sapling tawa growing strong and vigorous (Fig. 5). We find that the rata are, in the main, well up on the ridges—the survivals, apparently, of a general rata retreat before the tawa advance. The great forest-tree that supports the rata in its juvenile stage is the rimu, and consequently it may be inferred that a rimu association preceded that of the rata, or else the rata could not have developed into the large forest-trees seen on the ridges. As far as the regeneration and development of the primary forest is concerned, the black-beech now plays no part on the lower slopes. The beech, then, would appear to be either the survival remnant of a once high-altitude forest, or else the remnant of the first forest that clothed the lowland, but which for ages has been located on

the poorer ridges, this habitat being maintained because the processes of weathering and of plant-decay which have made soil for the lowlands are rendered null and void, owing to the fact that the waste is removed down to the lower levels almost immediately it is formed. Thus on the ridges there is virtually continually exposed the original dry, rocky-soil material which characterized the surface countless ages ago, while the lowland soils have been so improved and added to that other forest-trees have been able to oust the beech entirely from these soils.

As the beech is the remnant of a physiologically dry-condition forest, so the kahikatea is the remnant of a low-lying, wet-condition forest. Development on a stationary land-surface, it would appear,

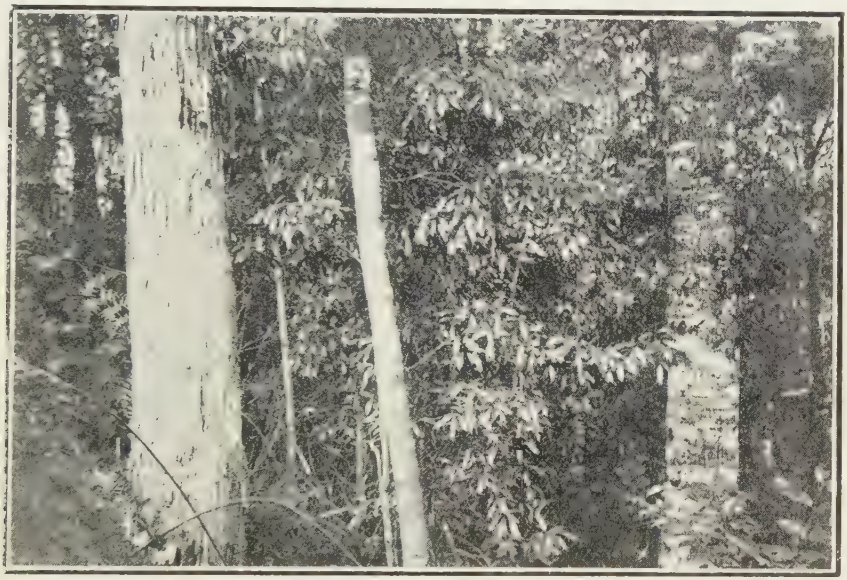

FIG. 5. PRIMARY FOREST OF THE TOTARA, REWAREWA, KAMAHI, BLACK-BEECH TYPE IN PROCESS OF BEING REPLACED BY TAWA.

The tree-trunks to the left and to the right respectively are totara and beech. The sapling-trunk and the willow-like foliage are those of young tawa.

[*Photo by E. B. Levy.*

all tends towards the middle or average state—*i.e.*, that state, as far as moisture content is concerned, midway between the physiologically dry-condition forest, on the one hand, and the wet swampy forests of the flats, on the other hand. The tawa is essentially a tree admirably suited to the moderately wet soils, and thus essentially suitable to form the forest climax. One other fact that supports the contention of the tawa climax is that tawa forest can reproduce itself *in situ*, the young tawa establishing well in the shade of the parent forest-tree. There are very few other forest-trees capable of reproducing themselves in this way. Kahikatea, miro, rewarewa, and hinau may successfully establish in their own shade, but most of our forest-trees—rimu, rata, kauri, beech, kamahi, &c.—demand more light than penetrates to the

floor for the successful establishment of their seedlings; consequently such forests must have open land bordering them into which they can extend, or else depend for their continued occupation of the soil on their ability to compete for the bared ground rendered available for occupation on the death of a parent tree. Of those trees mentioned earlier only the beech seems capable of doing this.

In making tawa the climax forest-tree of the Taranaki back-country I am confirming the work of Cockayne,* who states: "Tawa forest may, I think, be considered the final stage in the series of succession forming taxad forest; that is to say, whenever it occurs one may conclude that forest rich in taxads previously occupied the ground. In support of this view, all degrees of intermediate stages exist between the rimu and tawa forests."

THE ORDER OF DEVELOPMENT OF SECONDARY SCRUB AND SECONDARY FOREST ASSOCIATIONS.

In the initial grassing of the hill country under consideration there is an incessant struggle against secondary-scrub growth—water-fern (*Histiopteris incisa*), bracken-fern (*Pteridium esculentum*), manuka (*Leptospermum scoparium*), wineberry (*Aristotelia serrata*), &c.—which types of vegetation constitute really the first phases in the succession back to forest. Nature all the time is endeavouring to win back the area to forest, and in a district of fairly good soil and heavy rainfall the advantage is all with the secondary growth. In the Taranaki back-country there is no set of grasses at present known that could be used which in themselves would be sufficiently strong and aggressive to annul the great tendency of that country to revert to secondary growth. The all-important factor of stocking must come in to assist the grasses sown.

It is the writer's intention, before actually considering the suitable pasture species and their establishment and management on this country, to set out in a fairly detailed way the type of secondary scrub and secondary forest one meets with, and to show how every type of vegetation that arises is part of nature's plan to afforest once more those denuded hill-slopes. In other words, the succession from the forest-burn back to standing primary forest will be considered step by step. This study is important because if we know the sequence of events and the consequences of a certain method of treatment, then are we the more able successfully to avoid that which is undesirable and attain that which is desirable. Where the objective is good grassland, nature has to be combated at every turn, and as we consider the types of secondary growth that arise under different farm-management it will be seen that she is by no means a mean adversary. The grassing of forested hill country is a man's job, and too seldom do we realize the grit, perseverance, and foresight displayed by our pioneer settlers who have struggled and won against great odds.

A succession normally begins with a bared surface — termed the "initial surface"—and it presupposes that all or most of the original plant cover has been destroyed. This is so in the case of the settler's forest-burn. The forest is felled in the winter or early spring and left

* L. Cockayne, *The Vegetation of New Zealand*, Leipzig, 1921, p. 139.

FIG. 6. WINEBERRY FORMING THE FIRST PHASE OF THE SECONDARY FOREST.

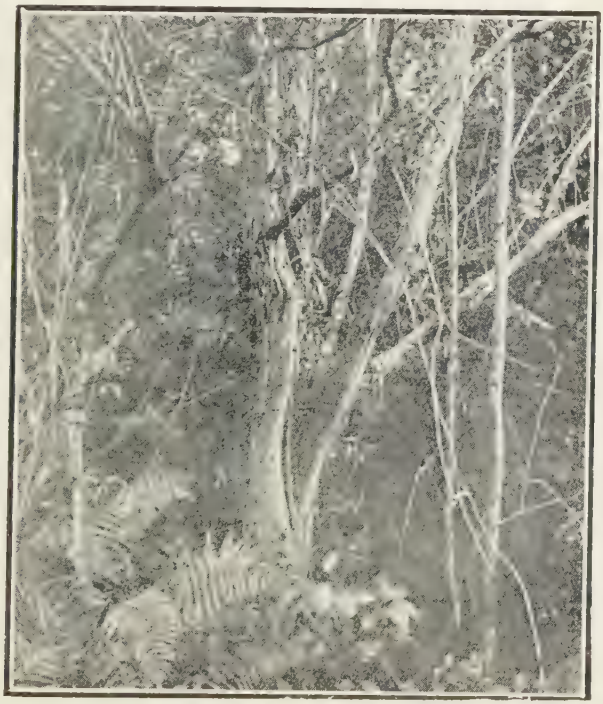

FIG. 7. TREE-FUCHSIA, TUTU, AND LACEBARK IN THE FINAL STAGES OF THE FIRST SECONDARY-FOREST PHASE.

Note the ferns and other growth on the floor, leading up to the final phase of the secondary forest.

[*Photos by E. B. Levy.*

to dry until the following autumn. If the season is settled, the later the burn can be left the better. The seeds are sown on the ashes even while these are yet warm. In addition to this sowing there is another set of seeds well and truly planted on the forest-burn. These latter may be spoken of as "volunteers." They consist largely of indigenous species—some seeds, some spores—and also of certain wind-borne introduced species, such as spear-thistle (*Carduus lanceolatus*) and catsear (*Hypochoeris radicata*). For the first two or three years there may be a dense volunteer association of spear-thistle, and, where the grass has failed to take, the rosettes of catsear may form, even in the second year, a pure association. So long as the spear-thistle does not grow too rank or dense there is not much harm done to the grass sward, but if the big rosette plants form so that the turf becomes much shaded there is bound to be damage.

In the third and fourth years the native plants begin to manifest themselves, and particularly is this true if the take of grass has been poor or has quickly run out. A reduced grass cover means the withdrawal of stock, and it must be remembered that stock is the biggest factor in secondary-growth control. So long as we can keep stock in fairly large numbers on the area there is scarcely any danger of secondary growth. Thus the stocking of the new forest-burn will have a very decided influence in determining just what secondary scrub establishes.

THE SUCCESSION ON A BADLY BURNT AREA, UNSTOCKED.

If a burn is such that only a very poor take of grass is possible there is not the same establishment of catsear or spear-thistle. The area cannot be heavily stocked, and fern and scrub growth immediately makes its appearance. Weki also may grow out afresh from their unburnt trunks. Water-fern is the most characteristic fern of these bad burns, but soon there comes to be associated with it wineberry, lacebark (*Hoheria populnea*), tree-fuchsia (*Fuchsia excorticata*), and tutu (*Coriaria sarmentosa*). On the poorer ground there is not so much water-fern, and wineberry, lacebark, and tree-fuchsia may be absent. Bracken-fern and tutu here come in. In steep shady places there may be large masses of tupari (*Blechnum capense*), while on the open sunny knolls kamahi may re-establish. The bracken-fern phase and the succession from this point will be considered later.

In the early secondary-forest growth following on a bad burn wineberry is easily the leader, and it may form quite a dense association from an early period (Fig. 6). Tree-fuchsia and lacebark really come in a little later than the wineberry, but the three ultimately intermingle to form the first secondary-forest phase of the succession back to primary forest. As the wineberry, tree-fuchsia, lacebark, &c., raise their branches higher a certain amount of light filters in on to the floor, and so soon as this happens further species of trees establish (Fig. 7). Mahoe (*Melycitus ramiflorus*), karamu (*Coprosma robusta*), kanono (*Coprosma grandifolia*), rangiora (*Brachyglottis repanda*), hangehange (*Geniostoma ligustrifolium*), patete (*Schefflera digitata*), fivefinger (*Nothopanax arboreum*), red-pepper tree (*Drimys colorata*), lancewood (*Pseudopanax crassifolium*), tarata (*Pittosporum eugenioides*), kohuhu (*Pittosporum tenuifolium*), kaiku (*Parsonsia heterophylla*), and kaikomako

FIG. 8. A MASS OF PIRIPIRI ON A FIVE-YEAR-OLD BURN STOCKED SOLELY WITH SHEEP.

FIG. 9. HARD FERN (IN CENTRE) ESTABLISHED AND SPREADING OVER A DRY KNOLL IN A RECENT BURN.

Note the catsear occupying the remaining portion of the knoll, and, towards the top of the photo, piripiri.

[*Photos by E. B. Levy.*

(*Pennantia corymbosa*) are among the most common trees that come in. Moisture- and shade-loving ferns such as *Asplenium bulbiferum*, *Goniopteris pennigera*, &c., also make their appearance. It is to such an association that is here given the term "secondary forest." It is essentially a shady and fairly moist forest, and, unquestionably, conditions in such a forest are entirely propitious for the establishment of the primary-forest trees. What is more, it is here that certain of the forest-trees establish, and it is not until these conditions arise that such trees as tawa or miro can successfully do so. Kahikatea and rimu also may establish here, but these can and usually do establish very well in much more open secondary forest, as will be mentioned later.

The foregoing is essentially the normal process of regeneration on the better soils and under no stocking whatsoever. We may with safety look upon any soil that goes through a dominant wineberry-lacebark-mahoe phase as being good potential grassland soil. Such is the succession in the gullies and better slopes of the Taranaki back-country.

SUCCESSION AFTER A GOOD BURN AND WITH LIGHT STOCKING.

Reverting back to the forest-burn, and presupposing a clean burn and a fairly successful take of grass, spear-thistle and catsear, as before mentioned, occupy their quota of ground. On the bare knolls also piripiri (*Acaena Sanguisorbae*) will have successfully established, and if the area felled was forest into which sheep have had access, or if the burn has been stocked in the first year with sheep from piripiri-infested areas, then this plant may be very common on all the drier knolls where the grass has failed to take. If such a piripiri-infested burn is stocked entirely with sheep, so soon as the grass surrounding the drier knolls is eaten bare the piripiri will spread, and in five or six years under constant sheep-grazing an almost pure association of this plant will have resulted (Fig. 8). Under cattle or mixed stocking it does not spread, and is gradually reduced until it virtually disappears. Hence on cattle-country it takes no part in the succession.

In the second or third year of the new burn, in the shade of logs and around stumps, water-fern and hard fern (*Paesia scaberula*) establish themselves. Hard fern also occupies dry knolls, establishing firstly in some shady crevice or niche of the knoll (Fig. 9), and then spreading outward by means of its wiry overground runners. Stock do not care for these two plants, and no matter how hard-pressed they may be they will not eat hard fern. At fairly high altitudes where there is more rain water-fern may form, under light stocking, an almost pure association. Hard fern, however, is the more important one as far as natural afforestation is concerned. Stock do not eat it, and once it gets well established and just so long as the area is kept stocked and the grass thus kept short the hard fern will spread. Ultimately the clumps will have so enlarged and the feed be so reduced that all stock, practically speaking, are forced off the area (Fig. 10). In this hard-fern association, then, we have a very decided phase in the succession to forest.

While the spread of hard fern has been going on, and particularly under sheep-stocking, the next phase in the succession has commenced. Bracken-fern, under light stocking, makes its appearance in

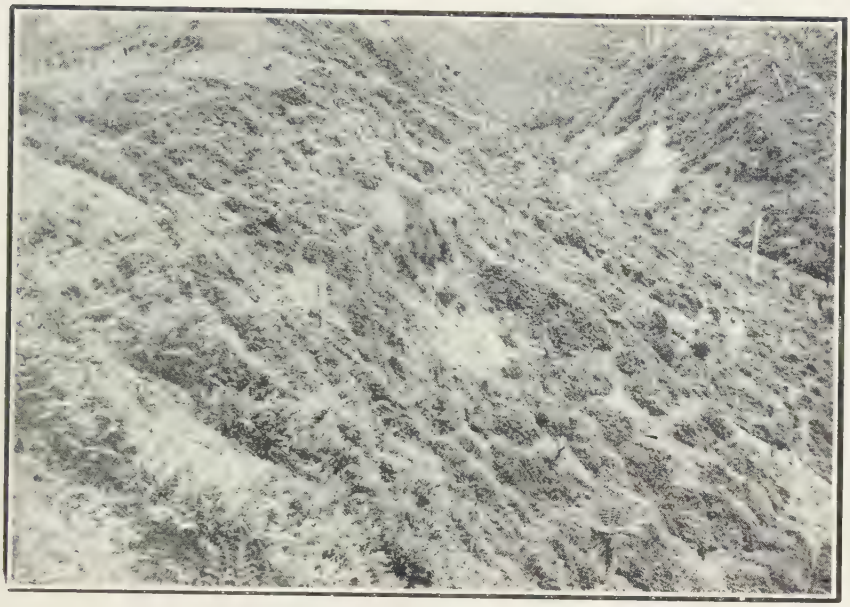

FIG. 10. THE HARD-FERN PHASE IN THE SUCCESSION.

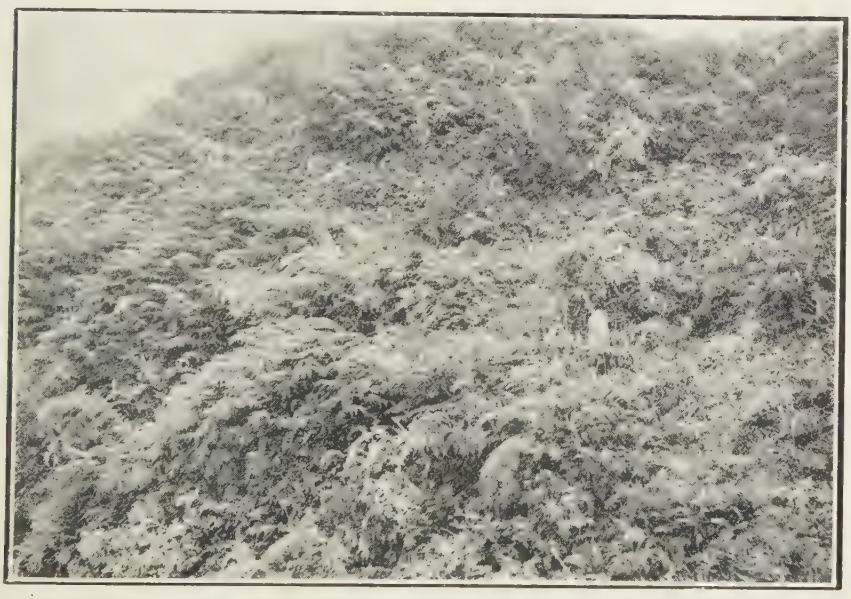

FIG. 11. HARD FERN ON A LIGHTLY STOCKED AREA BEING REPLACED BY BRACKEN-FERN.

In nearly all hard-fern patches on this slope the bracken was well established.

[*Photos by E. B. Levy.*

FIG. 12. THE BRACKEN-FERN PHASE IN THE SUCCESSION.

FIG. 13. BRACKEN-FERN ON A GOOD, DAMP SLOPE INVADED BY WINEBERRY.

Owing to the fact that wineberry can soon overtop bracken the latter is replaced.

[*Photos by E. B. Levy.*

the forest-burn three or four years after the forest-fire. It establishes in shade, under strewn branches or around logs, but it can and does also establish in the central portion of the water-fern and hard-fern patches (Fig. 11). By its strong underground rhizome its spread outward is fairly rapid, and so soon as no cattle run on the area the bracken-fern invasion is fairly fast. Sheep will scarcely eat bracken-fern at all, particularly when the frond is expanded, but cattle keep it well eaten down when forced on to it. Hard fern, and water-fern to a lesser extent, are non-shade endurers. Bracken-fern is a very much taller-growing plant than either of its fellows, and by its growth and spread it forms in the course of four or five years so dense a cover over the hard fern and water-fern that these become entirely killed out, leaving the bracken-fern in sole command of the situation (Fig. 12). The bracken-fern association may therefore be looked upon as another phase or step of the succession back to forest.

If the burn has been of a very intense nature, so that all forest-tree seeds have been killed out, this bracken-fern phase in the succession may last for hundreds of years. In the Taranaki back-country, however, burns are seldom so intensely hot that this happens. In this country, in the gullies and better soils, the next step in the succession begins after four or five or more years. Wineberry, lacebark, fuchsia, and tutu make their appearance—wineberry in particular (Fig. 13)—and now begins the replacement of the bracken-fern and the commencement of the secondary-forest cover, the processes and future development of which are almost identical with that which arises from the initial wineberry association already dealt with.

The bracken-fern phase does not necessarily follow on the hard-fern phase. It may take place in four or five years after the burn, particularly if very little stocking has been carried on. On the country too poor for wineberry and its associates bracken-fern may form the first step in the succession back to forest. Whether, however, the steeper fern-slopes have been derived from the initial burn or after the hard-fern phase their replacement in the Taranaki back-country by secondary forest is much the same. On this higher and drier fern country wineberry scarcely takes any part in the replacement. Tutu is perhaps the prime successional species, but bush-lawyer (*Rubus australis*) also comes in, and in the barer places appear koromiko (*Veronica salicifolia*), manuka, and karamu. The replacement is slow, and it may be twenty or thirty years or longer before there is much appearance of these shrubs among the bracken. In certain slightly richer soils the replacement is, however, more rapid, and once begun other trees come in. Lancewood, fivefinger, kohuhu, tarata, mahoe, kamahi, rangiora, putaputaweta (*Carpodetua serratus*), and hangehange are among the chief (Fig. 14). We thus get in forty or fifty years' time a secondary forest of a somewhat different type from that of the rather better and damper soils of the gullies and better slopes. This type develops into the primary forest by a replacement of certain of its members, and by the addition of certain other primary-forest trees which establish either in the course of the development of the secondary forest or in the shade of the association when well grown. Kamahi develops tremendously and may form an almost pure association, but, generally speaking, while the

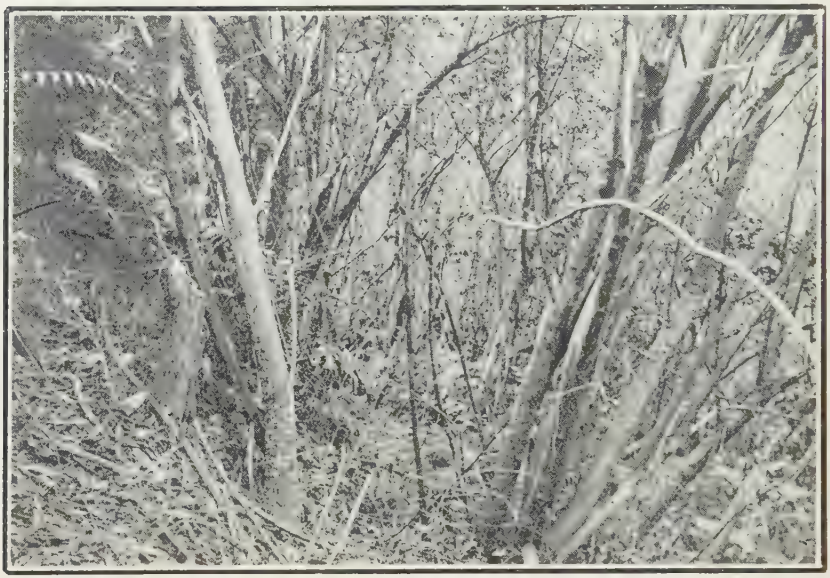

FIG. 14. TUTU IN THE FINAL STAGE OF THE FIRST SECONDARY-FOREST PHASE.

On the floor of this association the following plants were well established : Mahoe, fivefinger, karamu, kanono, hangehange, miro, weki, *Blechnum discolor*, *Asplenium bulbiferum*, *Goniopteris pennigera*.

FIG. 15. THE MANUKA PHASE IN THE SUCCESSION, MANUKA RAPIDLY BECOMING DOMINANT.

[*Photos by E. B. Levy.*

FIG. 16. THE BEGINNING OF THE SECOND FOREST PHASE AFTER MANUKA-SCRUB.

The manuka has been cut down (note stumps), and kamahi (1) and mahoe (2) will be noted established on the scrub floor.

FIG. 17. SECONDARY FOREST, SIXTY YEARS OLD, AT TAHORA.

Showing in the photo are fivefinger, totara, kamahi, wineberry (dead and dying), and manuka.

Photos by E. B. Levy.

kamahi are quite small, hinau, rewarewa, totara, and possibly rimu establish themselves, and a mixed forest of these trees may exist for a long time. These forests by their growth during perhaps hundreds of years increase the humus content; hence the humidity of the forest-floor, and thus tawa is able to become established. In the meantime rata-vines will have established on the rimu (rata needs fairly open association forest to establish successfully), and by the time the tawa forest is mature the rimu forest is almost entirely replaced by rata. It is this forest state which exists mainly on the hill-slopes of the Taranaki back-country to-day.

SUCCESSION FOLLOWING ON CLOSE AND CONTINUOUS GRAZING.

There is yet another way by which nature attains her goal of a forest cover. Let us go back to within some ten years after the forest-burn that has partly run to hard fern and partly to bracken-fern, but which is yet sufficiently well stocked to control the bracken. Unless the pasture is well constituted and correctly managed the grasses sown will have become weakened, and the turf will have opened considerably. The constant grazing will have removed much fertility from the land, and unless this loss has been made good in one way or another the soil then really becomes too poor for the bracken-fern to spread very much. It is at this point that nature brings a very formidable agent to bear —manuka, the curse of the poorer hill country, comes in (Fig. 15). Once isolated plants become established the spread of manuka is remarkably rapid, and in six to eight years after its first appearance a dense manuka association may be formed. In the Taranaki back-country manuka is becoming very troublesome on the poorer and even better slopes which have become reduced in surface-fertility by injudicious stocking and poor pasture-management. Manuka is the plant nature uses regularly for afforestation processes on country too poor for bracken-fern, and so soon as the grass-sward begins to open up on the country in question manuka seems ready to invade that soil. The manuka association is therefore a phase in the succession back to forest on those soils that have been impoverished and which have failed to hold a sward of grass. The wineberry, the bracken-fern, and the manuka are really three equivalent stages in nature's afforestation processes. The manuka association remains very dense and bushy for some years, but as the development proceeds the canopy top is lifted higher—and once more subdued light penetrates to the scrub floor. Again we find the secondary forest establishing, but the process here is slower, for the conditions of soil are still too poor to allow of rapid growth. As soon as sufficient light enters, kamahi and mahoe establish. Rangiora also comes in soon after, and this latter species is often a very important one in the afforestation of manuka areas, but it may be quite thirty years before this stage is reached. In the Taranaki back-country kamahi and mahoe establish quite well among manuka on the better soils (Fig. 16), but where the greater depletion of soil-fertility has gone on these appear later. Pimelia (*Pimelia prostrata*), snowberry (*Gaultheria antipoda*), gaultheria (*Gaultheria rupestris*), mingi-mingi (*Leucopogon fasciculatus*), and club-moss (*Lycopodium volubile*) establish along with the stunted manuka, or on extremely depleted soils these may even precede the manuka. In such an association

FIG. 18. ESTABLISHMENT OF FINAL PHASE OF SECONDARY FOREST IN THE ASSOCIATION SHOWN IN FIG. 17.

Rewarewa on left; kamahi on right; *Lycopodium volubile* covering the floor; and *Gaultheria antipoda* (behind rewarewa) also showing.

FIG. 19. MATURE SECONDARY FOREST IN THE FOREGROUND—KAMAHI, REWAREWA, LACEBARK (DOWN GULLY), AND FIVEFINGER.

In the background is the original primary forest—rewarewa, hinau, tawa, and kamahi mainly.

[*Photos by E. B. Levy.*

fivefinger may establish in abundance, and this is then followed closely by kamahi and totara. On the floor of such an association kamahi may readily re-establish, and here we find also the rewarewa quite at home.

Thus here we have perhaps one of the quaintest secondary forests to be found anywhere in New Zealand (Fig. 17). Fivefinger is the dominant tree, with odd totara and kamahi scattered here and there. In the better lower parts one or two wineberries may be seen, now old and decrepit. The lower story is filled with scrub—thin sapling manuka, scrubby kamahi, snowberry, and odd lancewood—in parts draped with dense masses of club-moss. Here perhaps club-moss is repeating its life-function of millions of years ago, preparing the way, now as then, for the great advance of the higher flowering-plants. As the conditions in this association improve, kamahi, rewarewa, and lancewood establish in greater numbers (Fig. 18), and this number is added to by totara, kohuhu, and tarata; and on the floor tupari may appear. This forest continues its development. The kamahi, rewarewa, fivefinger, tarata, kohuhu, lancewood, &c., grow into small forest-trees, and the underscrub of mingimingi, gaultheria, snowberry, and club-moss perishes. We then have once more the typical forest of the poorer slopes (Fig. 19), which ultimately will give way by degrees to tawa.

At Tahora, in a secondary forest such as this, may be seen the stately rimu setting out in truly graceful beauty to win back for that soil the primary forest that is in fact its heritage.

GENERAL.

From the foregoing it would appear that on the country in question secondary growth baffled the farmer at every turn; but secondary growth of a good character, vigorous and quick-growing, tells rather of possibilities of a country than of impossibilities. It tells of wealth in those soils if only this can be directed into channels useful to the farmer. A systematic study of this country is urgently needed, so that there may be sorted out and trials made of those pasture-species and methods of pasture-management which are seen to be giving the desired result.

(To be continued.)

A Twenty-one-year-old Ewe.—Mr. M. R. Findlay, Inspector of Stock, Kurow, Otago, sends the following note: "Longevity among our domestic animals is not often brought under notice, unless it is the age of some faithful horse which has served a shepherd or family for life, or perhaps a pony which has carried all the junior members of a household to school, while the ripe old age of some of our faithful canine friends is also at times commented upon. It is only on rare occasions that old age among sheep calls for particular attention. A ewe, the property of Mr. James Menzie, of Rosehill, Hakataramea, should just about be given pride of place in this respect, for, as the saying goes, she is 'old enough to vote.' This animal was born in January, 1902, from a Merino ewe by a Border Leicester ram, and was raised as a pet. She has reared seventeen lambs, but for the past three seasons has not been put to the ram, her owner wishing to see how long he can keep her alive. Unlike most pet sheep, she was never a fencer, a fact which no doubt saved her from the butcher's hook years ago."

STUD-STOCK BREEDING.

ADVICE REGARDING SHEEP.

Paper communicated to the New Zealand Board of Agriculture by Mr. W. PERRY, "Penrose," Masterton.

IT is with a feeling of diffidence that I consent to give an opinion on breeding of stud animals. The experience I have had has been wholly with long-woolled sheep, and I am of opinion that methods that will work out quite well when breeding Merino sheep, on account of their purity and evenness of type, will not be satisfactory with long-woolled sheep.

Having been in charge of a Lincoln flock for forty years, a Romney flock for sixteen years, and an English Leicester flock for ten or twelve years, it has given me a very good opportunity of following different methods of breeding and watching results, and has practically brought me to the conclusion that none of the systems, such as in-and-in breeding, line-breeding within the same line of blood, line-breeding with unrelated families, or consistent outcrossing, can be followed exclusively when breeding long-woolled sheep. Undoubtedly close breeding or keeping within the same blood is the only way to produce great and valuable sires, but there are limitations beyond which the breeder must not go. Great judgment is required in this matter to know when the danger-line has been reached. The loss of vitality comes on gradually and is not easily detected; the wool-covering is affected as well.

There is a lot of literature on breeding, and most of the writers quote the pedigrees of champion animals as being closely inbred; but nothing is known of the percentages of failures the breeders of those animals had in their matings. There is no straight road to success. With all the advantages possible, it is not so difficult to reach a high standard with a flock as to maintain it.

There are several recognized methods of breeding—namely, (1) In-and-in breeding; (2) line-breeding with distant strains of the same blood; (3) line-breeding with distinct families; (4) outcrossing, which means continuous change of blood.

The method of outcrossing is very misleading to the young breeder. If he is careful to select sires similar in appearance to his flock he will apparently produce some useful-looking animals at first, but the more fresh blood he introduces the more uneven will be the result. I had this experience when I first started with Lincoln sheep, and did not do any good until the method of line-breeding was adopted. Rams bred on the outcross principle are no good to the stud breeder, and very little better for the ordinary flockmaster. Sheep bred in this way are much like the crossbred: they mature quicker than the line-bred sheep, and at two-tooth they look very promising, but do not last; and the result of mating them with crossbred ewes will be anything but satisfactory. Any one who has read and studied Mendel's

laws of heredity will quite easily understand why the outcrossing methods cannot lead to any great success.

There is no question that many breeds have been made by the method of in-and-in breeding, which means the mating of nearly related animals; but once a breed is established there does not seem so much need to practise it to any great extent. It is decidedly useful, if one procures an outstanding sire, to mate a few nearly related ewes of the same family and type, the progeny of which, if successful, would be very valuable; but to continue would, I think, only be courting trouble. Before attempting to inbreed it is necessary to have an intimate knowledge of the history of the animals to be mated. I have tried mating in this way with varying success; in one particular instance the result was a decided success.

Line-breeding with distant strains of the same blood is the ideal system. By selection leading faults can be eliminated, family lines can be established, and a flock, if large enough, can be carried on a number of years on these lines improving all the time. But there comes a time when, if some fresh blood is not introduced, the young sheep will be slower to mature and harder to get into condition, and will show less covering on their points and a general falling-away in vigour. I had this happen with my Lincoln flock, and if a flock is allowed to go too far it takes quite a time to bring it back to normal. To avoid this happening, a safe method is to purchase a few outstrain ewes, use the home ram on them, and if the results are satisfactory use the half-blood through the flock. It may be that selection has something to do with slow maturity after a flock becomes closely bred for some years. A good sire in either the Lincoln or Romney breeds must have a lasting fleece—*i.e.*, it should grow good wool until four or five years old. A sheep which will carry sound wool until that age is invariably a very firm-fleshed animal and free from excessive fat. These animals are a little slower in coming to maturity, and the more you inbreed them the more you intensify the slow-maturing qualities.

Line-breeding with distinct strains of blood is no doubt a safe method for the beginner, but the great difficulty is to get a number of separate strains of blood of equally good quality and alike in type to start with. It would take years to bring a flock bred in this way to anything like evenness.

To be successful at stud breeding a person must have a natural gift for observing the good and bad points and the general characteristics of each animal; by so doing he will know all his best animals by sight, which is of great assistance when dealing with the flock.

The safest method the young breeder can adopt is to make up his mind on the type of sheep he would like to breed, select his stock from the breeder whose sheep come nearest to this ideal, and continue doing so as long as the parent flock continues to be up to standard. As time goes on, if he is a keen observer of his animals, he will be able to analyse them at a glance. When this stage is reached, success should crown his efforts. Suitable climate and soil for the particular breed are essential; good judgment in selecting and mating, and good judicious feeding are all necessary before success can be obtained.

STINKING-SMUT OF WHEAT.

I. THE EFFECT ON GERMINATION OF SOME SEED-DISINFECTANTS.

J. C. NEILL, Wellington.

THE disease of wheat known as stinking-smut, sometimes called covered smut or bunt, is due to one or both of two closely allied fungous parasites, *Tilletia Tritici* (Bjerk.) Wint. and *Tilletia levis* Kuehn. From the earliest historical times, and in all countries, it has caused greater aggregate loss to the grower than any other wheat-disease, and in New Zealand it is still the most formidable enemy of the wheat crop. Where no preventive measures are taken stinking-smut may take anything from 5 per cent. to 40 per cent. of the crop; and, further, even a small percentage of smutted heads lowers greatly the market value of the wheat, rendering it unfit for milling, while badly smutted lines are unsuited even for use as fowl-feed.

Fortunately, since the discovery of the hot-water, bluestone, and formalin treatments of the seed-wheat it has been possible, under such conditions as prevail in the New Zealand wheat-growing areas, to reduce the amount of stinking-smut normally present to very small proportions.

In New Zealand the main, and possibly the sole, cause of infection is by means of spores of the fungus which become attached to the seed during harvesting and threshing. When the seed is sown the fungus-spores germinate at about the same time as the wheat-seed, and, sending out germ-tubes, which penetrate the tender seedlings, become established in the tissues of the growing plant. As the wheat-plant grows, the fungus grows with it, showing no outward sign of its presence until flowering-time, when it establishes itself in the young wheat-grains. Here the fungus grows rapidly at the expense of the food material stored in the grain, finally converting the whole contents of the seed-envelope into a black mass composed of millions of the fungus-spores. The name stinking-smut is derived from the peculiar rancid smell given off by these "smut balls," which imparts a distinctive mustiness to flour milled from wheat in which they are present in any quantity. As the outside coat of the grain is still intact it is only by fairly close observation of the wheat-ear that the presence of the smut can be detected. When the crop is harvested and threshed the smut balls are more or less broken, distributing over the clean wheat their millions of contained spores, which adhere so tenaciously that no mechanical cleaning process will remove them.

In countries where a summer fallow system is practised, notably in north-western America, infection of the soil by wind-borne spores liberated from the threshers becomes, in some years, a factor of great importance in the spread of smut. If the autumn wheat is sown in

such infected soil while dry, then, after the first rain, both wheat-seed and smut-spore germinate together—an ideal condition for the parasite. Previous treatment of the seed would in this case be largely ineffective in preventing infection, the most hopeful method lying in the breeding of immune varieties of wheat. Fortunately, only very exceptionally are such conditions likely to occur in New Zealand.

Under present conditions, therefore, the problem of stinking-smut control in this country consists in finding some means whereby the smut-spores carried by the wheat-seed may be destroyed without injury to the wheat itself, and which will be cheap and easy to apply under farm conditions. A review of the published accounts of experiments to this end conducted in other countries shows that the best results in the past have been obtained by various modifications of the hot-water, bluestone, and formalin dips. Hot-water treatments, though effective if properly applied, are not adapted to farm practice, and so are not included in the present inquiry.

Practically all observers agree that both the formalin- and bluestone-dip treatments, if properly carried out, will completely prevent infection by seed-borne spores, but there is equal agreement that both injuriously affect the germination of the wheat. Injury to the seed-coat of the grain in threshing seems to be the predisposing cause of this harmful action of the fungicide, as the germination of hand-threshed seed does not appear to be materially affected.

Microscopical examination of samples of two of the wheats, presumably machine-threshed, used in the experiments here recorded showed injuries as follows: Pearl—Uninjured, 65 per cent.; seed-coat broken, over endosperm, 7 per cent., over embryo, 26 per cent.; embryo broken off, 2 per cent. Tuscan—Uninjured, 80 per cent.; seed-coat broken, over endosperm, 3 per cent., over embryo, 15 per cent.; embryo broken off, 2 per cent.

Hand-threshed seed is not a commercial possibility in New Zealand, but every effort should be made in machine threshing to minimize injury, and samples of seed-wheat that show much broken seed-coat when viewed under a hand-lens should be rejected.

Various modifications of the standard bluestone- and formalin-dip treatments have been recommended, the most promising of which are being tested in these experiments. Unfortunately, it has not been possible to test in the laboratory the current farm practice of sprinkling and turning on a floor as compared with the complete dip, but it is hoped to do this later under practical farm conditions.

The question as to whether delay in sowing seed which has been treated will injuriously affect germination is one of great importance, especially in a wet winter such as experienced this year. Formalin in particular has a bad reputation in this respect, but an elaborate inquiry in the United States by Hurd shows that post-treatment injury only takes place at humidities below 70°, a degree of dryness rarely attained by New Zealand air in winter. Further, it is stated that damage by formalin can be entirely avoided by washing in water after treatment. Part of the present series of experiments is designed to verify these statements, though a complete test can be made only under field conditions.

In recent years two other promising methods for the disinfection of seed have been discovered—a dry treatment with copper-carbonate dust, introduced by Darnell-Smith in New South Wales in 1917, and a wet process using certain organic mercury compounds (uspulun, germisan, chlorophol, &c.), which has given good results in Germany, and which it is hoped to test here when supplies of the compounds become available. The copper-carbonate dry-dusting treatment of Darnell-Smith offers many practical advantages over any of the wet methods, and it is claimed for it that germination is rather increased and strengthened even after prolonged post-treatment storage. While showing good results in the recorded experiments on smut-control, there appears to be some doubt as to whether it is as effective as the formalin or bluestone. This can only be settled for local conditions by careful field experiments in the wheat-growing areas of New Zealand.

The present high cost of copper carbonate—about 6s. per pound—is a distinct disadvantage, though it is expected that if the demand increases the cost of production will be considerably reduced. Used at the standard rate of 2 oz. per bushel of seed the cost of treatment will be 9d. per bushel, as against 3d. per bushel by the present methods. Still, if by using copper carbonate the rate of sowing can be reduced from $1\frac{1}{2}$ to $1\frac{1}{4}$ bushels per acre—representing 1s. 6d. at 6s. per bushel—at an increased cost of $6\frac{3}{4}$d., then there is a net gain of $11\frac{1}{4}$d. per acre in addition to the convenience and ease of handling.

Another dry treatment, using a mixture of anhydrous copper sulphate and limestone, has given fairly good results in the United States, and it has the advantage of being considerably cheaper in cost of material.

The usual farm practice in New Zealand is to treat the seed-wheat with either bluestone or formalin, which, although giving fairly satisfactory results in the control of smut, is considered to reduce germination to such an extent that an additional 10 to 20 per cent. of seed must be sown to ensure the requisite stand.

Taking the total seed-wheat used in New Zealand at 400,000 bushels, the annual loss due to this excess sowing is from 40,000 to 80,000 bushels. At 6s. per bushel this represents a cost to the growers of from £12,000 to £24,000 per annum. The primary object of the present investigation is to find how this wastage may be reduced or perhaps eliminated.

I wish to acknowledge the assistance received from the Officer in Charge and the staff of the Biological Laboratory, Wellington, wherein the preliminary work recorded here has been performed—especially to Mr. N. R. Foy, Seed-analyst, and his assistants, who carried out all the germination tests here recorded; to the Mycologist, Mr. G. H. Cunningham, for laboratory facilities and constant advice. Mr. F. E. Ward, Instructor in Agriculture, Christchurch, also supplied much helpful information.

PRELIMINARY LABORATORY EXPERIMENTS.

These experiments were planned to give reliable data on one factor only of the stinking-smut problem—that of the actual effect on wheat-seed, germinated under ideal conditions, of the more promising standard

methods of disinfection. The corresponding effects under field conditions, and the relative efficiency in control of the smut, will be taken up in future work in the field.

Methods.

Samples of seed were obtained from the Instructor in Agriculture, Christchurch, and three were selected (to represent the three classes of wheat chiefly grown in New Zealand)—namely, Pearl, College Hunters, and Purple-straw Tuscan. From each of these, twenty-four lots of 100 seeds (fair average sample) were counted out, placed in corked test-tubes, and treated in duplicate as follows :—

(1.) Dry-dusting with copper carbonate. Weights of dry, finely powdered copper carbonate, equivalent to weights of ½ oz., 1 oz., 2 oz., and 3 oz. per bushel, were vigorously shaken with different samples of the seed.

(2.) Dry-dusting with a mixture of 50 per cent. finely powdered anhydrous copper sulphate and 50 per cent. finely powdered calcium carbonate. Weights of the mixture, equivalent to weights of 1 oz., 2 oz., 3 oz., and 4 oz., were shaken with the seed as in No. 1.

(3.) Bluestone dip : 1 lb. bluestone (copper sulphate) in 10 gallons water.

(4.) Bluestone dip : 1 lb. bluestone in 5 gallons water.

(5.) Formalin dip : 1 pint commercial formalin in 40 gallons water. Each of the dip treatments (Nos. 3, 4, and 5) were tested in four different ways as follows :—

A. Sample covered with the dip solution for ten minutes, then surplus solution poured off and sample left in wet mass for twenty minutes, then spread out on blotting-paper in room to dry overnight.

Aw. Sample treated as in A, but rinsed in clean water immediately before being spread out to dry.

B. Presoak method : Sample first covered with clean water for ten minutes, then surplus water poured off and seed left in wet mass for six hours, then treated as in A.

Bw. Presoak method plus wash : Sample presoaked as in B, then treated as in Aw.

Three series of each wheat were thus treated. One lot was placed in the germinators on the day following treatment ; the other two lots were stored in corked test-tubes till tested, one at fourteen days and the last lot at twenty-eight days after treatment. With duplicates and untreated controls a total of 378 samples of 100 seeds each were tested for germination. The results are set out in the accompanying tables.

The following references apply to the bluestone and the formalin treatments in each of the three tables :—

A treatment—Cover with solution 10 minutes, drain 20 minutes, then spread out to dry.

Aw—Same as A, but treated seed washed in water before drying.

B—Soaked in water 10 minutes, drained 6 hours, then treated as in A.

Bw—Same as B, but washed in water after treatment and before drying.

Table I. Seed placed in Germinators One Day after Treatment.

Treatment.	Germination Percentage.															
	Pearl.				Hunters.				Tuscan.				Average of the Three Varieties.			
Counts at	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days
Copper Carbonate.																
½ oz. per bushel ..	95	95	95	95	82	91	91	91	89	96	96	96	88	94	94	94
	96	97	97	97	78	90	90	91	86	95	95	95				
1 oz. per bushel ..	97	97	97	97	77	98	98	98	83	96	96	96	82	96	96	96
	95	95	95	95	67	94	94	94	73	94	95	95				
2 oz. per bushel ..	93	96	96	96	76	95	95	95	87	96	98	98	84	96	96	96
	97	98	98	98	77	96	97	97	84	93	95	96				
3 oz. per bushel ..	94	95	96	96	88	96	96	91	86	94	95	95	84	94	94	94
	92	94	94	94	77	95	95	95	76	93	93	94				
50-per-cent. Mixture of Copper Sulphate (anhydrous) and Calcium Carbonate.																
1 oz. per bushel ..	95	95	95	95	86	90	90	91	87	96	96	96	90	94	94	95
	97	97	97	97	92	97	97	97	84	93	95	96				
2 oz. per bushel ..	95	96	96	96	94	95	95	95	88	95	95	96	91	94	94	95
	95	95	95	95	86	92	92	92	85	95	96	96				
3 oz. per bushel ..	99	99	99	99	89	92	93	93	89	96	96	96	91	95	95	95
	100	100	100	100	86	91	92	92	83	94	94	94				
4 oz. per bushel ..	95	95	95	95	94	99	99	99	91	96	98	98	91	96	96	96
	91	93	93	93	88	97	97	97	90	95	96	96				
Bluestone (1 lb. in 10 gallons water)																
A	42	77	90	90	40	93	94	95	36	69	84	86	35	78	89	91
	37	76	96	96	27	79	82	86	30	68	89	91				
Aw..	72	97	97	97	..	..	..	..	54	77	84	84	53	82	92	92
	61	95	96	97	..	..	..	..	39	88	92	92				
B	41	79	91	92	43	76	83	87	47	79	91	94	30	79	88	89
	35	80	88	89	37	78	86	87	33	80	87	89				
Bw..	52	82	85	88	..	..	..	..	52	82	90	93	51	82	88	91
	56	85	89	91	..	..	..	..	47	82	88	91				
Bluestone (1 lb. in 5 gallons water).																
A	39	71	92	96	12	74	88	91	39	64	86	83	32	69	87	90
	39	65	88	92	20	77	85	88	44	67	90	92				
Aw..	44	88	96	97	14	72	86	87	50	84	93	93	33	79	91	92
	37	76	92	92	22	79	96	96	31	86	92	93				
B	21	61	79	84	25	63	82	85	33	75	91	93	26	62	84	84
	16	52	73	77	25	56	72	79	38	67	85	86				
Bw..	50	78	92	93	54	75	86	90	51	84	91	91	49	86	89	91
	54	86	91	95	40	70	82	87	40	87	94	94				
Formalin (1 pint in 40 gallons water)																
A	97	99	99	99	61	94	94	94	66	94	94	95	70	94	94	95
	93	95	95	95	67	96	91	91	76	94	94	94				
Aw..	90	92	92	92	84	93	93	93	83	99	99	99	86	96	96	96
	98	98	98	98	84	94	94	94	88	99	99	99				
B	88	90	91	91	88	97	97	97	85	93	93	93	86	92	93	93
	95	95	95	95	75	83	85	85	90	98	98	98				
Bw..	93	94	94	94	70	90	90	90	92	95	95	95	87	94	94	94
	98	98	98	98	72	91	91	92	96	97	97	97				
Untreated.																
Controls	95	96	96	96	..	..	..	..	81	98	98	98	88	97	97	97
	95	96	96	97	55	94	94	95	89	96	96	96				
	95	97	97	98	49	94	94	94	94	98	98	98				
	94	100	100	100	..	..	..	..	98	99	99	99				

Table II. Seed placed in Germinators Fourteen Days after Treatment.

Treatment.	Germination Percentage.															
	Pearl.				Hunters.				Tuscan.				Average of the Three Varieties.			
Counts at	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days
Copper Carbonate.																
½ oz. per bushel ..	95	95	..	95	80	93	93	93	94	96	96	96	92	95	95	96
	96	96	..	96	92	97	97	97	95	96	96	97				
1 oz. per bushel ..	94	95	..	95	83	91	92	92	93	96	96	96	90	94	95	95
	89	94	..	94	84	95	95	95	97	97	97	98				
2 oz. per bushel ..	93	94	..	94	80	93	95	96	93	94	94	94	91	95	95	95
	95	96	..	96	93	97	97	97	91	95	95	95				
3 oz. per bushel ..	94	94	..	94	83	94	94	95	86	92	93	93	91	94	94	95
	92	96	..	96	81	98	98	98	92	94	95	95				
50-per-cent. Mixture of Copper Sulphate (anhydrous) and Calcium Carbonate.																
1 oz. per bushel ..	94	96	..	96	89	92	92	92	97	97	97	97	92	94	94	94
	98	98	..	98	86	89	89	90	87	90	90	90				
2 oz. per bushel ..	97	98	..	98	86	90	90	90	94	96	96	96	91	96	96	96
	92	96	..	96	80	97	97	97	97	100	100	100				
3 oz. per bushel ..	94	96	..	97	83	95	95	95	90	93	93	94	90	94	94	95
	97	98	..	98	80	92	92	92	96	96	96	96				
4 oz. per bushel ..	97	97	..	97	89	94	94	94	95	95	95	97	93	95	95	95
	97	97	..	97	84	93	93	93	95	96	96	96				
Bluestone (1 lb. in 10 gallons water).																
A	56	81	..	94	61	82	91	94	65	76	83	85	57	78	88	91
	35	73	..	89	62	82	88	92	61	76	85	90				
Aw..	54	91	..	96	..	..	..	..	58	78	86	90	62	84	84	93
	78	96	..	97	..	..	..	..	59	73	83	90				
B	54	80	..	90	63	77	86	90	61	76	86	89	51	77	85	89
	41	74	..	89	52	86	90	92	57	70	80	84				
Bw..	63	89	..	94	..	..	..	..	69	85	88	90	70	88	92	93
	65	88	..	93	..	..	..	..	85	93	96	97				
Bluestone (1 lb. in 5 gallons water).																
A	32	54	..	81	35	64	80	84	40	54	70	77	35	56	69	82
	30	50	..	88	38	66	81	84	38	49	66	80				
Aw..	39	82	..	92	47	72	87	92	41	57	79	86	45	71	82	90
	49	80	..	95	52	75	84	88	42	59	77	88				
B	18	52	..	78	46	73	85	89	25	44	71	76	32	55	77	78
	9	26	..	61	44	72	78	85	19	64	74	81				
Bw..	27	71	..	88	46	74	82	84	63	69	81	85	42	71	81	86
	23	70	..	90	39	75	81	85	55	67	81	84				
Formalin (1 pint in 40 gallons water).																
A	93	96	..	96	33	95	95	95	67	80	84	85	65	88	89	92
	96	96	..	96	30	83	90	90	70	81	87	90				
Aw..	95	95	..	95	82	91	92	92	85	87	87	87	87	91	91	93
	98	98	..	98	79	90	92	92	86	90	93	93				
B	89	96	..	96	91	93	93	93	89	92	98	98	91	94	95	96
	90	94	..	95	95	96	96	96	94	95	96	97				
Bw..	93	94	..	95	97	99	99	99	96	97	97	97	94	96	96	96
	95	97	..	97	91	95	95	95	92	93	95	95				
Untreated.																
Controls	96	99	..	99	94	95	95	95	95	96	96	96	93	95	95	95
	94	96	..	96	86	92	92	92	90	92	92	92				
	96	97	..	97	..	..	..	..	96	98	99	99				

Table III. Seed placed in Germinators Twenty-eight Days after Treatment.

Treatment.	Germination Percentage.															
	Pearl.				Hunters.				Tuscan.				Average of the Three Varieties.			
Counts at	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days	3 days	6 days	10 days	14 days
Copper Carbonate.																
½ oz. per bushel ..	96	96	97	97	91	99	99	99	77	97	97	97	88	96	97	97
	97	00	00	00	86	93	93	93	77	94	95	95				
1 oz. per bushel ..	95	98	98	98	89	92	92	92	62	98	98	98	83	95	95	95
	93	94	94	94	79	94	94	91	80	95	95	96				
2 oz. per bushel ..	91	99	99	99	84	98	98	98	70	97	97	98	81	95	96	96
	86	92	93	93	89	94	94	94	68	92	93	94				
3 oz. per bushel ..	90	94	94	94	88	94	95	95	64	95	95	95	81	94	95	95
	92	95	95	95	85	94	94	94	66	95	97	97				
Anhydrous Copper Sulphate and Calcium Carbonate.																
1 oz. per bushel ..	95	95	95	95	92	98	99	99	79	99	100	100	93	96	97	97
	93	96	96	96	87	94	94	94	90	96	97	97				
2 oz. per bushel ..	94	95	95	95	91	97	97	97	80	96	96	96	88	95	95	95
	94	97	97	97	88	90	90	91	79	94	94	94				
3 oz. per bushel ..	94	98	98	98	90	97	98	98	81	98	98	98	89	96	96	96
	96	98	98	98	90	95	95	95	81	95	95	95				
4 oz. per bushel ..	95	99	99	99	91	94	94	94	80	96	96	96	87	96	96	96
	96	97	97	97	90	93	94	94	71	95	96	96				
Bluestone (1 lb. in 10 gallons water).																
A	21	62	85	86	33	83	87	88	11	66	85	91	29	72	86	89
	30	70	89	93	50	77	82	84	10	76	91	95				
Aw..	42	89	92	93	..	..	..	..	13	76	88	89	26	82	91	92
	30	82	93	94	..	..	..	..	20	81	91	93				
B	8	43	71	76	40	80	84	85	10	71	86	88	20	63	81	83
	14	52	80	91	43	76	83	84	9	60	83	85				
Bw..	21	82	94	94	..	..	..	..	14	63	76	77	18	68	84	84
	25	65	87	87	..	..	..	..	12	64	79	80				
Bluestone (1 lb. in 5 gallons water).																
A	25	50	83	86	31	59	72	78	8	49	73	78	22	52	74	79
	32	52	78	84	27	60	73	77	10	44	66	75				
Aw..	25	81	92	92	34	75	87	88	25	77	91	95	28	72	87	88
	30	80	96	96	45	67	83	84	12	54	73	76				
B	7	28	64	69	18	55	65	68	7	55	72	80	12	47	68	74
	11	41	71	80	21	51	61	68	12	56	75	81				
Bw..	15	53	74	78	36	61	77	78	21	66	81	86	33	60	78	81
	11	59	83	86	32	64	72	73	19	66	81	83				
Formalin (1 pint in 40 gallons water).																
A	93	97	97	97	21	85	88	89	4	88	91	91	39	90	92	93
	92	98	98	98	20	82	88	89	4	89	91	92				
Aw..	96	96	96	96	71	91	92	92	26	88	90	90	65	90	92	92
	95	96	96	96	67	83	85	86	35	88	91	91				
B	91	96	96	96	86	94	94	94	67	92	93	93	84	93	93	93
	95	95	95	95	93	95	95	95	70	90	90	90				
Bw..	93	94	94	94	86	90	90	90	87	95	96	96	86	92	93	93
	92	93	95	95	85	94	94	94	78	87	88	88				
Untreated.																
Controls	86	94	94	94	76	99	99	99	91	97	97	97	84	97	97	97
	91	97	97	97	86	97	97	97	88	97	97	97				
	88	97	97	97	..	..	..	..	85	95	95	95				
	..	..	..	..	..	..	..	..	84	95	95	95				

SUMMARY OF EXPERIMENTAL RESULTS.

(1.) *Dry-dusting Treatments.*—Neither the copper-carbonate nor the anhydrous-copper-sulphate and calcium-carbonate mixture caused any appreciable damage to the wheat-seed in vitality or germinating-power.

(2.) *Bluestone-dip Treatments.*—The bluestone dip in all cases injured the germinating-power and vitality of the wheat-seed. This injury increased with the increased strength of the dip, and also with the length of time that the seed was held in storage after treatment. Washing in water after dipping materially reduced this injury. The presoak methods increased the injury caused by bluestone. Deterioration on post-treatment storage was more pronounced with the varieties Pearl and Tuscan than with Hunters.

(3.) *Formalin-dip Treatments.*—The effect of the formalin dip varied considerably with the different wheat varieties. Pearl appeared to be uninjured by the dip even after twenty-eight days' post-treatment storage. This result is very surprising when considered in relation to the large amount of broken seed-coat in the sample, as specified earlier in this article. Hunters showed a certain retardation of germination the day after treatment by all the formalin-dip methods. After post-treatment storage for fourteen days the vitality of the seed was distinctly impaired. This was reduced by washing the seed in water after dipping, and was entirely eliminated by the preliminary presoak method. The twenty-eight-days post-treatment storage results showed a decrease in vitality all round—reduced to small proportions by presoaking. Tuscan gave results very similar to Hunters, with slightly greater advantage by presoaking.

GENERAL.

The experimental laboratory results here recorded, while in part agreeing with the published records of work in other countries, cannot be accepted as a reliable practical guide until confirmed and extended by field trials in New Zealand.

The methods which show least damage to the seed may not be efficient in controlling the smut, and a method showing good laboratory results may be impracticable on the farm. Further, the relative cost of each method must be balanced against its efficiency.

The most instructive feature of the tabulated results lies not in the total germination, but in the proportion of seed which had germinated at the third-day and sixth-day counts respectively. It is probable that in the field very few of the seedlings whose germination is included in the subsequent counts would ever develop to grain-producing plants.

Quick and strong germination of the seed is a vital factor not only in the subsequent vigour and productivity of the crop, but also in immunity from attack by stinking-smut and other parasitic fungi.

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TESTING OF NEW-ZEALAND-GROWN WHEATS.

III. BAKING-TESTS OF FLOURS.

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PRACTICAL tests being always the more convincing, it was considered advisable, in continuation of the testing of New-Zealand-grown wheats, to corroborate by actual baking-tests information obtained from the chemical examination of flours, and to illustrate if possible the truth of the statement that the protein content of a wheat (or flour) is generally a fair measure of its strength. Baking-tests of the flours from wheats which were experimentally milled have now been successfully carried out in this Laboratory. For the results of the chemical analyses the reader is referred to Table II in this series, in the August issue of the *Journal*.

Bread, according to T. B. Wood, is the product of cooking or baking a mixture of flour, water, and salt, which is made porous by the addition of yeast. Several varieties of the process of breadmaking are practised, but for the purposes of these tests the "straight-dough" process was used, and for the following reasons: It required less time, it was easier to control the temperature-changes over a comparatively short period than over the longer periods of the other methods, and the results were likely to be more accurate.

It is at once apparent that in making tests on different samples it is imperative that they should be so conducted that the differences in results are due to the inherent qualities of the flours themselves, and not to modifications of the method used. It is therefore of importance that the conditions under which the tests are carried out should be strictly the same in every case. These conditions are maintained chiefly by careful regulation of the temperatures from the time the dough is first mixed to the time the bread is finally removed from the oven.

METHODS OF BAKING (STRAIGHT-DOUGH PROCESS).

In order to maintain the necessary temperature conditions the different ingredients were warmed to 35° C. before being incorporated in the dough; this was thoroughly mixed and kneaded, weighed, and allowed to ferment for a specified length of time in a fermentation-chamber kept also exactly at 35° C. Here the dough was allowed to rise to a maximum height, when the amount of rise and the time taken were noted, and the dough again weighed. It was then immediately put into the oven, which was kept at 220° C.; the loaf was baked at that temperature for thirty-five minutes. With each series of loaves—only six of which could be baked at a time—a commercial "baker's" flour was included for purposes of comparison and for standardization of the various series.* On being taken from the oven each loaf was removed at once from its tin, weighed, and cooled as quickly as possible. After standing for one hour the volume of each loaf was measured.

To produce bread of good quality from the point of view of size, uniformity of texture, &c., the dough (in other words, the gluten) must be elastic—that is, it must expand or "rise." The volume of a loaf is a measure of this elasticity, and, it follows, of its quality. Having baked the loaf and measured its volume, other things (colour, &c.) being equal, a practical measure of quality or strength is obtained.

In each case exactly the same amounts of each ingredient were used for the tests, and each dough received exactly the same treatment, except that (*a*) the amount of water added was suited to the requirements of the flour as shown by the absorption-of-water figure, and (*b*) the fermentation period was varied to allow a maximum expansion to be reached in each case; in the case of weaker flours this period was generally longer than with stronger samples.

BAKING-TESTS.

It will be remembered that in the second article of this series it was said that the amount of protein present was probably the best single measure of the strength of a flour. A series of loaves containing high to low amounts of protein, and illustrating this statement, is shown in Fig. 1. It is at once apparent that here No. 2 is easily the best as regards volume, and that the value of the others is in descending order of protein content. No. 1 is from the commercial flour baked with each series. The largest loaf is from a sample of Velvet grown at Middlemarch, Upper Taieri, on the borders of the arid district of Central Otago. The other samples are included only in order to illustrate the influence of protein content on loaf-volume, and, not being representative of their particular varieties, their names are not given.

From a consideration of protein content it was said in the same article that "P 467, a sample of White Tuscan, contained a moderate amount of protein"—that is, its strength also would be expected to be moderate only; also that "the samples of Victor gave generally very good yields of flour, but in 1922 appeared in most cases to be lacking in strength. P 322 was a sample above the average for the variety."

* This sample of good average commercial "baker's" flour was obtained from a local warehouse. It was assumed, if this sample gave the same loaf-volume each time, that the necessary conditions were maintained during each baking with the requisite degree of accuracy.

EFFECT OF PROTEIN CONTENT ON LOAF-VOLUME.

FIG. 1.

No.	Protein.	Half-loaf Volume.
	Per Cent.	c.c.
1	..	600
2	13·19	663
3	10·94	563
4	9·88	479
5	8·56	434

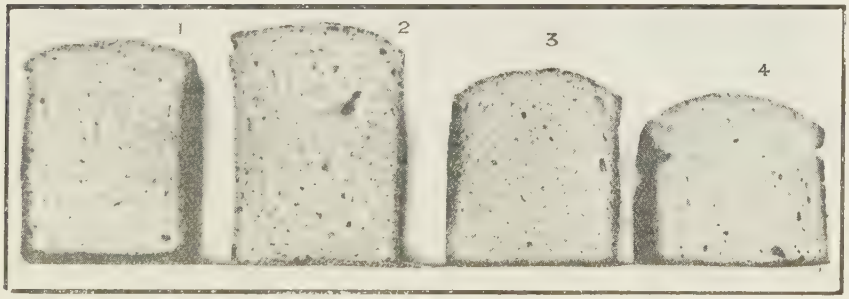

FIG. 2.

No.	Variety.	Protein.	Half-loaf Volume.
		Per Cent.	c.c.
1	Commercial "baker's" flour	..	600
2	Velvet (P 290)	13·19	663
3	White Tuscan (P 467)	9·88	479
4	Victor (P 322)	9·63	397

[*Photos by F. T. Leighton.*

Fig. 2 shows the results of the baking-tests of these two samples compared with the sample of Velvet (P 290), already illustrated, and a standard sample. The White Tuscan and Victor samples were the best all-round samples of their varieties received in 1922; it is fairly obvious that they do not compare favourably with the sample of Velvet, which was in strength only a little above the average for that variety in 1922. As a matter of fact, this sample of Victor is not even such a good wheat as its protein content would suggest. On comparing it with loaf No. 5, Fig. 1 (loaf-volume 434 c.c.*), it will be seen that its loaf-volume (397 c.c.) is less, though it contains over 1 per cent. more protein. This is due to factors which are not discussed in the present article. Loaf No. 4 shows the poor texture of the bread produced from this weak flour. While speaking of Velvet it may be interesting to point out that another sample of Velvet with protein 14·88 per cent. gave a loaf-volume of 690 c.c.

Of some Tuapeka samples it was said in the preceding article that "Thew . . . contained a very good amount of protein (12·50 per cent.)," and that "Marquis . . . in certain American States fetches highest prices. . . . The milling-yield [of this particular sample] is good, and it still contains a good percentage of protein." These two flours were baked because they were considered representative of the very interesting wheats obtained from Dumbarton, near Roxburgh, and which were actually grown at the Moa Seed-farm. Fig. 3 fully bears out the foregoing statements.

Referring to Fig. 3, for purposes of comparison these samples were photographed alongside the best samples of some other varieties received. Nos. 2 and 4 are obviously much better samples than 3 and 5, and there is no doubt which is of the most value to the miller, the baker, and the consumer.

One interesting point about this series (Fig. 3) is that Marquis, with a smaller protein content than Thew, yet produced a loaf of larger volume. Here is one of the exceptions to the rule that protein content is a measure of strength. At the same time there is never any doubt as to these two wheats producing flour of very good quality, even if one is an exception to the general rule. In this baking-test is perhaps the key to the statement quoted above that "Marquis fetches highest prices."

At the time when analytical figures only were available it was stated that "one of the outstanding samples milled in 1922 was the sample of Burbank's Super grown at Flaxton, Eyre County. Its protein content was as high as 14·44 per cent." The loaf baked from this flour is No. 3, Fig. 4. It will at once be seen that the baking-tests since carried out have quite confirmed the analytical results obtained some months ago. This sample of Burbank's Super produced a loaf of excellent volume. Alongside it (No. 2) is the poorest sample of wheat received in 1922, containing only 7·69 per cent. protein; this is illustrated, of course, only for purposes of comparison and of general interest, and is obviously not representative of its variety. No. 4 is the best sample of White Tuscan received at this Laboratory in 1922, and the loaf on the extreme right is the good sample of Velvet previously referred to. There is not much doubt about Burbank's Super being one of "the outstanding samples milled in 1922."

* c.c. = cubic centimetre ($\frac{1}{16}$ cubic inch approximately).

EFFECT OF PROTEIN CONTENT ON LOAF-VOLUME—*continued.*

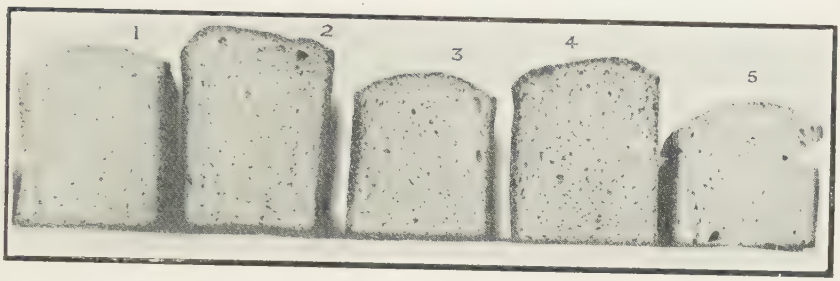

FIG. 3.

No.	Variety.	Protein.	Half-loaf Volume.
		Per Cent.	c.c.
1	Commercial "baker's" flour	..	600
2	Marquis (P 429)	11·44	666
3	White Tuscan (P 467)	9·88	511
4	Thew (P 432)	12·50	600
5	Victor (P 322)	9·63	397

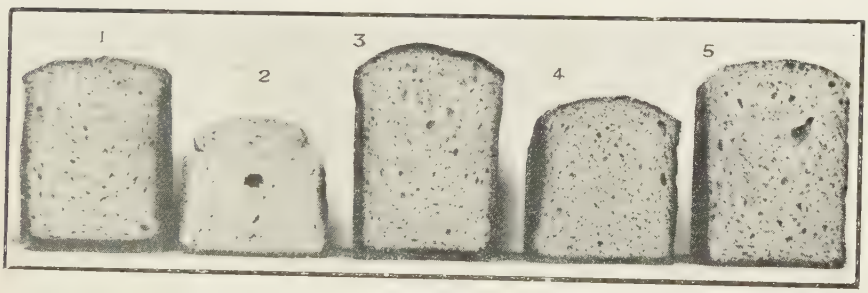

FIG. 4.

No.	Variety.	Protein.	Half-loaf Volume.
		Per Cent.	c.c.
1	Commercial "baker's" flour	..	600
2	Purple-straw Tuscan (P 319)	7·69	352
3	Burbank's Super (O 815)	14·44	726
4	White Tuscan (P 467)	9·88	511
5	Velvet (P 290)	13·19	663

[*Photos by F. T. Leighton.*

NOTE.—The relative sizes of the different loaves are not the same in all the photos—*i.e.*, one photo cannot always be compared with another as regards the apparent loaf-volumes. This, of course, does not apply to loaves in the same illustration.

GENERAL.

In connection with the whole question of experimental milling of wheat and testing of flours many pertinent questions might be asked. For instance:—

(1.) Does the yield of flour from the experimental mill correspond with the yield obtained when the wheat is milled on a commercial scale?

(2.) Does the flour obtained experimentally produce on baking a loaf of good colour, appearance, and palatability?

(3.) Do the wheats called "strong" and "medium strong" produce flours comparable with flours of a similar classification in other countries?

(4.) Are the baking-tests comparable with the results obtained by the baker?

(5.) Does the protein content of a flour bear any useful relationship to the loaf produced?

It is thought that these and other questions can now be satisfactorily answered, and they will be briefly discussed in the same order.

(1.) It has already been stated that the percentage of ash is an indication of the skill shown in milling. According to various authorities the amount of ash in a straight grade flour (such as is milled in this Laboratory) should be at least 0·48 per cent.; it is said in effect that if a flour contains less than this amount the flour has not been so thoroughly removed from the grain as when it contains more. On the other hand, if it contains more than 0·90 per cent. ash the wheat has been overmilled.

The whitest flour comes from the centre of the grain; the strongest and best (the most glutinous) is situated just beneath the covering, which in milling is separated as bran, &c. The miller concentrates on separating as perfectly as he can this better-quality flour from the bran, otherwise microscopic bran-particles will find their way into the flour-stream and reduce its quality, colour, &c. The bran of the wheat-berry is considerably richer in inorganic substances (compounds of calcium, magnesium, phosphorus, potassium, &c.) than the flour; if bran therefore finds its way into the flour the inorganic content of the latter becomes greater. In determining the ash, one determines the amount of these inorganic compounds present, and in this way obtains an indication of the purity of the flour. If the ash is too high, a part of the bran has probably found its way into the flour; if it is too low—since the whiter central portion contains not only less protein but also a smaller amount of inorganic compounds—not enough of the richer outer layer of flour has been removed from the bran.

It will be seen on reference to Table II, published in the preceding article, that none of the samples milled here exceeds the limits mentioned above. Further than this, the flour, if it had not been satisfactorily separated from the outer husk of the grain, would have been of a dirty colour, and this would have shown itself in producing a bread of a dirty and disagreeable colour. Looking at this question from still another point of view, duplicate and triplicate results of

milling-tests agree as closely as can reasonably be expected (within 0·2 per cent.). This being so, it seems that the amount of flour obtained, being constant, is in effect a real measure of the flour available in the grain by milling processes under rigorously maintained conditions.

(2.) In answer to the second question it may be said that in every case where a flour was tested the bread in the samples above a certain strength has been of good texture when cut, and has possessed a colour as good as that of the commercial "baker's" flour which was baked with each series. The question of colour is interesting from a practical point of view, because in this Laboratory the mill is provided with nothing corresponding to the elaborate machines for cleaning the grain which form so indispensable and prominent a part of most modern mills; all cleaning is done here by hand, and at best must be imperfect.

The palatability of the strong samples has been as good as, and often better than, that of ordinary baker's bread. Externally the loaves were of a pleasing colour and well crusted; their texture was always found to be good with strong flours, decreasing in quality as the protein content became less, until finally the poorest sample might be said to have had no texture at all.

(3.) As regards comparison with samples of known and accepted good strength in other countries, the information in the left half of the following table was obtained from Bulletin 177 (1911) of the Kansas State Agricultural College Station. Kansas, it may be mentioned, is one of the leading wheat States of America.

Strong Wheats tested in Kansas.				New Zealand Wheats.			
No.	Variety.	Protein.	Loaf-volume.	No.	Variety.	Protein.	Loaf-volume.
		Per Cent.	c.c.			Per Cent.	c.c.
58	Malakoff ..	15·65	1,330	O 815	Burbank's Super ..	14·44	1,452
65	Fife ..	12·24	1,290	P 308	College Hunters ..	12·19	1,292
67	Minnesota..	12·62	1,310	P 290	Velvet	13·19	1,326
68	Bearded Fife	10·68	1,300	P 429	Marquis.. ..	11·44	1,332
70	Minnesota..	12·22	1,260	P 431	Thew	12·50	1,200
76	Turkey Red	11·15	1,140	P 259	Dreadnought ..	10·94	1,200

It will be seen that, judged by loaf-volume, strong and medium-strong New Zealand wheats lose nothing when compared with typical Kansas wheats of the same classes. For purposes of comparison the local figures are calculated on the same amount of flour that was used in the American experiments.

(4.) The method of experimental baking is the method of the baker, and does not differ from his except in special cases to be mentioned. It is essential for purposes of comparison that the tests should give the measure of the strength of the flour and thus reveal differences of quality. Really comparative tests are attained, then, only by very exact control of all the processes and of temperature, no one flour being favoured more than another. A skilled baker no doubt adapts his methods to suit the different flours he uses, and by the processes of kneading and fermenting improves a weak flour. But this does not prevent that flour from being essentially a weak flour,

and of less value ultimately, not only from the point of view of bread-making, but also from that of the extra time and labour necessary to remedy its inherent defects. The experimental baking-test still remains a real criterion of the true value of a flour.

(5.) There is no doubt that high protein content is generally associated with high loaf-volume (*i.e.*, flour-strength). This is apparent from the photos and the accompanying data.

CONCLUSION.

Of the numerous baking-tests made, a selection is given here of those which pointed the moral. They have been used mainly because they were available when the photos were taken, and because also they illustrate the main points of this and the preceding article. Tests with other samples confirm these results.

It is necessary to point out that, though analogies and comparisons should not be pushed too far, members of a single series are strictly comparable. Where baking-tests are often carried out over a number of weeks, and on days of which some are colder than others, it is evident that exact control of all the conditions is most difficult. For instance, it was found impossible to obtain a compressed yeast which was always of the desired uniform good quality; and it is a well-known fact, too, that the yeast-plant is very sensitive to small temperature-changes. The writer can only agree with the authority who said, "With all the care and the corrections noted . . . the difficulties of obtaining strictly comparable tests are more evident to the one who has made the tests than to any one else." Baking-tests, however, are undoubtedly of great value, any appreciable differences in quality being at once apparent; and, being practical demonstrations, they are the more convincing on that account.

Variation in Milk Test during Lactation Period.—Experience shows that a cow calving in good condition will probably both milk well and test high at the commencement of the milking-period, and that there will be a gradual decline in both milk and percentage of butterfat until the surplus condition is worked off the body and the latter is reduced to normal producing condition. On the other hand, a cow freshening in poor condition may be expected to give both a light yield of milk and a low test until the body is replenished as the result of more abundant and suitable feed, &c. There will then probably be a gradual increase in both test and fat until the maximum fat-production for the season is reached at about the fifth month. Tests at the end of the milking season are found to be influenced by the condition of the cow, the nearness to calving, and the season of the year, and accordingly may fluctuate either up or down.—*W. M. Singleton, Director of the Dairy Division.*

Cheese-colouring. — Last season some difficulty was experienced in connection with the colour in coloured cheese. It was at first considered that the colouring was faulty, and in some instances the trouble disappeared when the colouring-material was changed. In other instances colouring-material which when used at one factory produced inferior-coloured cheese was used without any trouble at an adjoining factory. It would appear that some milks have a reducing effect on colour which does not obtain with other milks. The trouble is being investigated bacteriologically by the Department.

ASHBURTON EXPERIMENTAL FARM.

NOTES ON OPERATIONS, SEASON 1922–23.

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In this review of the past season's work at the Ashburton Experimental Farm much of the subject-matter is naturally a continuation of the two previous years' reports, and those interested are advised to study it in conjunction with the latter, which appeared in the *Journal* for September, 1921 and 1922 respectively. As in previous years, the notes have been compiled from the reports of Mr. J. G. McKay, Farm Overseer, who has carried out the work in his usual able manner.

PASTURE EXPERIMENTS.

Permanent Pasture.

Tall oat-grass having proved a failure as a permanent-pasture grass, this area was ploughed to the depth of 4 in. in the spring (1922), with the idea of trying another permanent grass-mixture. Owing to the presence of yarrow in the old sward the infested areas were cross-ploughed and grubbed once, the balance of the area remaining summer-fallowed on the one furrow.

The eradication of twitch and yarrow is a question of considerable importance in Canterbury, and no definite instruction can be laid down on this matter owing to variations of climate and soil. In the field under consideration, however, most of the yarrow was killed on the cross-ploughed section, and this method has much to commend it. Cross-ploughing cuts the turf into blocks which are thrown up in a rough state, thus allowing them to dry out during favourable weather. Continuous grubbing of yarrow and twitch-infested lands tends to consolidate the ground beneath the surface. Should wet weather then set in, stray pieces of roots are more likely to strike than if confined to the blocks as thrown up by cross-ploughing.

With the idea of ascertaining the subsequent effects of a deep ploughing on the growth and life of cocksfoot and clover, a portion of once-ploughed land was deep ploughed to a depth of 7 in. An application of 2 tons of carbonate of lime per acre was made to a portion of the field, a seed-bed was prepared, and the following mixture sown on 20th March last: Perennial rye-grass, 6 lb.; cocksfoot, 15 lb.; crested dogstail, 2 lb.; red clover, 5 lb.; white clover, 2 lb. It is intended to carry out top-dressing experiments on this area at a later date.

Paspalum.

An attempt was made to establish *Paspalum dilitatum*. A mixture of 5 lb. paspalum, 20 lb. Italian rye-grass, and 2 lb. red clover was sown on 22nd September, 1922, but, though a good strike of rye-grass and clover has resulted, there is no sign of paspalum at date of writing. It is probable that the climate of Canterbury is too cold for this grass.

Top-dressing Old Pasture.

This pasture was sown down in 1917. It was divided into five plots in 1921, the subsequent treatment being as follows:—

Plot No.	Top-dressing, per Acre.	Date of Application.	Top-dressing, per Acre.	Date of Application.
1	10 cwt. slaked lime ..	19/8/21	5 cwt. burnt lime ..	2/6/22
	2 cwt. superphosphate ..	7/9/21	2 cwt. superphosphate ..	31/8/22
2	Control (no dressing) ..	..	Control (no dressing) ..	..
3	2 cwt. superphosphate ..	7/9/21	2 cwt. superphosphate ..	31/8/22
4	4 cwt. Nauru rock phosphate	7/9/21	4 cwt. Nauru rock phosphate	31/8/22
5	1 cwt. blood, 1 cwt. super	7/9/21	1 cwt. blood, 1 cwt. super	31/8/22

Contrary to the previous season's experience, the effect of lime and manures was very noticeable during spring and early summer. The growth of white and suckling clover was remarkable, especially on the lime and super plot, where all previously vacant spaces were occupied by clovers. Similar spaces on the control plot were filled by hair-grass, moss, and hawkweed.

These plots were grazed in conjunction with an adjoining paddock of young rye-grass and red clover, and the sheep at first preferred the old top-dressed pasture. In subsequent grazings both pastures were about equally favoured, with the exception of the control plot on the old pasture, which remained practically untouched. Right through the season the line where the control meets the manured plots has been clearly defined, especially so by the amount of roughage which remained on it during the autumn and winter. It appears that the plot which received lime and superphosphate was most relished by stock.

Temporary Pasture.

This consisted of two plots of 5 acres each—plot 1 being spring-sown with rape, and plot 2 autumn-sown after rape.

In the 1921–22 report it was stated that plot 2 showed the better sole of rye-grass, but plot 1 the better strike of clover. Plot 1 is now a much-improved pasture, considerable filling-in of rye-grass having taken place; the clover, however, is rather scanty. Plot 2 (autumn-sown) is better in this respect, particularly at the southern end, where the previous pasture contained a predominance of cocksfoot. This end of the pasture is apparently much relished by stock, all rye-grass, including heads, being closely cropped. The good stand of clover is probably accounted for by the heavy cocksfoot turf which was ploughed in, but that the incorporation of vegetable matter improves the palatability of a pasture has not previously been noted.

COCKSFOOT-SEED PRODUCTION.

As related in a special note in the *Journal* for July, 1922, cocksfoot grown on the Danish system—in wide drills and intercultivated—has done exceptionally well on the Ashburton Farm. This area was closed in autumn (1922) after having been cultivated, and was again cultivated during August. The seed-crop was harvested on 26th December and threshed last month. The area of 2·4 acres yielded 490 lb. of seed,

or 204 lb. per acre, not machine-dressed. The straw was shorter than that of the previous season's crop, and the heads apparently not so well filled. The weather was dry during the filling and ripening period. The aftermath has been grazed with sheep.

CEREALS.

Wheat Selections.

Crop results of wheat selected by officers of the Department and members of the farm advisory committee from 180 varieties grown on the farm in the previous season are tabulated below. The date of sowing was 30th May, 1922. Seeding was at the rate of 1½ bushels per acre, and the manuring superphosphate at 1 cwt. per acre.

Variety.	Date harvested.	Yield per Acre.	
		Firsts.	Seconds.
		Bus. lb.	Bus. lb.
Snowdrop	19/1/23	41 34	3 25
Pearl	10/1/23	40 51	3 35
White Tuscan (Cheviot) ..	10/1/23	37 59	1 4
Velvet (Ngapara)	19/1/23	37 16	2 52
Jumback	8/1/23	36 54	2 9
Red Fife	10/1/23	36 54	3 35
Johns Winter Fife	10/1/23	36 33	2 52
Essex Conqueror	19/1/23	36 1	2 52
Turretfield Eclipse	8/1/23	35 1	2 30
Queen Fan	8/1/23	35 50	4 18
Queen Fair	8/1/23	35 32	2 9
Kinver Red	19/1/23	35 7	2 52
Velvet Chaff	10/1/23	35 7	..
Major	8/1/23	34 24	2 9
Burbank	10/1/23	30 48	3 13
Zealand	10/1/23	30 26	4 18
Echo	30/12/22	30 6	4 18
White Fife	8/1/23	29 23	2 30
Marquis	8/1/23	29 23	1 47
Salter's Early	30/12/22	28 40	2 9
Triumph	10/1/23	Not taken	..
Bayah	Cut out (poor)	..	..
Bunge Federation	,,	..	..

Oats.

A number of varieties procured from the Irish Department of Agriculture have been sown for two seasons, but none of the samples of grain produced has as good an appearance as a well-grown sample of many clean commercial lines. The variety Victory showed promise of being a good green-feed oat in the early stages, but it rusted badly later. The varieties, being pedigree strains, were Black Tartar, Banner, Black Mogul, and Victory.

Barley.

Five varieties received from the Irish Department of Agriculture were sown, and several useful samples procured. One variety producing a long berry of the Cape-barley type was culled, but the following are being given a further trial: Archer, Archer-Goldthorpe, Archer-Sprat and Goldthorpe.

Cereals and Seed Vetches.

This experiment was planned to ascertain which is the best cereal to sow with vetches to prevent lodging of the latter, also to find out if any cereal would ripen and cast its seed earlier than the vetches, thus leaving a comparatively clean sample of vetch-seed. Four quarter-acre plots were sown on the 25th August with Scotch vetches at 1½ bushels per acre, together with the following cereals also at 1½ bushels per acre: Plot 1, Solid-straw Tuscan wheat; plot 2, Cape barley; plot 3, Emerald rye-corn; plot 4, Garton oats. Superphosphate at 2 cwt. per acre was used for manuring.

The plots were harvested on 3rd February. As a holding-up crop the order of preference was—(1) wheat, (2) rye-corn, (3) oats, (4) barley. None of the cereals had cast all its grain when the vetches were ready for harvesting, although probably two-thirds of the oats in plot 4 had shaken out.

TURNIPS AND RAPE.

A comprehensive experiment was planned with these crops, both manurial and seed tests being embodied. Owing to the ravages of aphis and diamond-back moth during a dry spell the crops were practically ruined. In the early stages, however, New-Zealand-grown rape and turnip seed both compared very favourably with the imported. Every plot which had an application of manure grew larger plants than were grown on the controls, but, as related in the *Journal* for May last, heavy applications of either superphosphate or basic super in contact with the seed lowered the germination considerably.

LUCERNE.

The first growth of the season showed great promise, the manured portion being particularly forward, but the crop was caught by a late frost when almost ready to cut, and was practically ruined. In all subsequent cuts the manured plots gave heavier yields than the unmanured plots. Grazing-tests were carried out on an area of 8 acres, the lucerne standing heavy stocking quite well. The carrying-capacity of this area, as represented by the sheep grazed during the growing season, gave the equivalent of 6·73 sheep per acre per annum.

There is evidently a certain amount of danger from bloat in grazing lucerne, particularly in the case of ewes and lambs, and lambs just off their mothers. Over a period of five weeks' pasturing five strong forward lambs and one store lamb died out of a total of 160. In the case of the five forward lambs death occurred on a morning following rain. The sixth lamb was scouring rather badly, and would possibly have died on any strong feed. Similar cases were experienced when pasturing ewes and lambs on the lucerne. Rain had fallen on two nights only during the pasturing-period, and on each day following one ewe died. Good-constitutioned wethers with some condition can be pastured safely enough on lucerne, and they do well.

It was also noticed that sheep's burnet growing in an adjoining gully was eaten more readily than the lucerne by all ages of sheep, and even the weed grasses and gorse hedges came in for their share of attention. It seems evident that lucerne alone did not satisfy the sheep, but whether this preference for other food indicates some deficiency in lucerne or simply a desire for a change of diet is largely a matter of conjecture.

POTATOES.

Continuing the previous season's trials on cut *versus* uncut seed the following results per acre were obtained :—

Variety.	Uncut Seed.				Cut Seed.			
	Table.	Seed.	Pig.	Total.	Table.	Seed.	Pig.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Dakota	5·05	1·52	0·30	6·93	3·95	0·80	0·24	4·99
Arran Chief	3·47	4·23	1·86	9·56	2·98	2·48	0·87	6·33
Reading Russet ..	10·44	4·48	1·99	16·91	9·07	3·24	1·49	13·80
Snowflake	11·31	2·87	0·99	15·17	10·70	1·74	0·23	12·67
Snowdrop	6·47	6·24	2·74	15·45	4·97	6·84	1·86	13·67
Bresee's Prolific ..	7·34	2·74	0·99	11·07	8·30	3·55	1·42	13·27
Manhattan	3·36	2·24	0·75	6·35	3·20	1·39	0·49	5·08
Up-to-date	1·86	1·74	0·86	4·46	1·84	2·48	0·74	5·06
British Queen ..	4·00	2·46	0·96	7·42	3·25	1·44	0·62	5·31
Average, 1922–23 ..	5·92	3·16	1·27	10·36	5·36	2·66	0·88	8·91
Average, 1921–22 ..	1·68	2·66	1·07	5·42	1·37	2·13	1·87	4·37
Average, 2 years ..	..	..	..	7·65	..	..	..	6·41

It will be noticed that only in the case of Bresee's Prolific and Up-to-date did the cut seed exceed the uncut in yield. The New Era variety was tested but not dug in the 1922–23 season.

BACTERIAL CONTAMINATION OF MILK AND CREAM.

HINTS FOR DAIRY-FARMERS.

L. S. BARRELL, Farm Dairy Instructor, Hokianga.

Milk as secreted in the udder of a healthy cow is germ-free. Contamination may take place in various ways: first, during the act of expressing the milk from the teat, as the opening from the milk-sinus to the outside is of such a nature that bacteria adhering to the mouth of the milk-duct are washed away with the first milk and therefore contaminate the whole milking. It will thus be seen that careful washing of the cow's udder is the first step in the endeavour to produce a bacterially clean milk. Thereafter there are different sources of contamination that can, with thought and care, be eliminated to a large extent. The chief sources lie in the use of unclean dairy utensils and the air of the milking premises.

Too much stress cannot be laid upon the importance of thoroughly washing all dairy utensils, and finally scalding them with boiling water and retaining them in this boiling water for a few minutes.

Contamination from the air is effected by the multitude of fine particles of dust that are ever present in the atmosphere of many

milking-sheds, each particle carrying its burden of living organisms which await more favourable surroundings, being unable to multiply until deposited in a medium containing the necessary moisture and food elements. These favourable conditions are found in milk, and the bacteria that thus find their way into the milk that is left standing about the dairy premises multiply with astonishing rapidity. Contamination by dust can to a large extent be prevented by having concrete floors which are kept well washed down, and by the immediate separation of the milk and removal of the cream, as soon as separated, to a cool well-ventilated detached dairy.

Leaving aside the pathogenic or disease-causing bacteria, we may briefly consider that class of organism responsible for most of our defective home-separated cream—namely, the lactic-acid and particularly the gas-forming groups. Each of these types is represented by varieties or species, which may have different effects on the flavour, texture, or keeping-qualities of the dairy-product.

The gas-forming bacterium gains access to the milk chiefly during the milking operation, through improper washing of the cow's udder or not washing the udder at all; dirty hands of the milker; and most likely through the dirty habit of wet milking, when the milk is badly contaminated by the drippings from the hands. The organism becomes attached to the teats and udder of the cow through contact with the earth when lying down, and particularly during the dry part of the season when cows are searching for water or succulent feed in swamps and about stagnant bog-holes. Its presence in cream is detected by fermentation, which usually begins to manifest itself within twenty-four hours, small bubbles of gas appearing on the surface. In bad cases it will be noted that the cream appears of a yeasty nature, and that its volume has visibly increased, due to displacement by the large volume of generated gases held in suspension. Cream when in this condition is not suitable for acceptance at the factory for manufacture into butter, as the fermentation is accompanied by a decidedly "off" flavour, and the aroma will vary with the particular species of gas-forming bacterium with which it is infected. Cream only slightly affected in this way has a flavour that the average dairyman will put down to feed, and he will not concern himself about the matter further. As a matter of fact, however, it has been shown that in nine cases out of ten where it is assumed that feed-flavour is present the defect is directly due to the presence of gas-forming bacteria, and therefore controllable.

During the hottest weather of last summer a local dairy-farmer asked for the writer's assistance in an endeavour to trace the cause of a peculiar flavour in his cream that had kept his grade down when he was making every effort to produce a superfine article. This persistent flavour would have been commonly classed as having origin in the feed, but it was proved on investigation to be due to bacteria of the gas-forming type, although gas was not formed to such an extent as to show fermentation. It was found that the dairyman had his utensils, milking-machine, dairy, and shed in first-class condition as regards cleanliness. A curd test was made from a composite sample of the milk of the whole herd, and this showed after the usual incubation period that the milk was affected by gas-forming bacteria.

Thus the line of action was quite clear. The following day the milking-machine, separator, and other utensils were thoroughly sterilized with boiling water, and the writer took charge of the four subsequent milkings covering the period from which the cream was sent to the factory, personally washing and wiping dry each cow's udder, and making this operation more effective by the addition of a small quantity of an odourless disinfectant to the washing-water. After each milking the machine plant, separator, cream-can, and other utensils were thoroughly washed and then sterilized with boiling water. Immediately after being separated the cream was removed from the separator-room to a dairy situated some distance from the shed, and therefore away from any likely source of contamination. Each skimming was kept separate, and stirred twice daily with a metal stirrer. Just before removal to the cream-stand to await transport to the factory the various skimmings were placed in a clean sterile can. From that day onward this farmer's cream has not failed to grade superfine, and has graded as high as 93.

Mention may be here made of a micro-organism that frequently causes trouble and was complained of by several dairy-farmers during last season the one responsible for ropy or slimy milk and cream. Cream affected by this bacterium assumes a viscid or slimy nature, and its colour becomes much paler, which at once indicates to the trained eye that something is amiss. This trouble is not as a rule accompanied by any objectionable flavour, but rather by a lack of flavour—that is, the cream does not possess that full rich flavour found in the product that grades superfine. As cream thus affected will certainly not make first-class butter, it is either classed second grade or rejected altogether, depending on the extent of its infection. This organism is introduced into the milk chiefly by means of the washing-up water, particularly during the driest period of the season, when sources of water-supply frequently become stagnant and are mostly infected. For this latter reason also the germ can be introduced by improper washing of the cows' udders. Its presence in milk or cream can be prevented by the same treatment as that mentioned in the case of gas-forming bacteria.

Finally, it is necessary to emphasize the importance of cooling for controlling the bacterial content of milk or cream. It is a well-known fact that those bacteria that form gas make their maximum increase at separating temperature—namely, between 80° and 95° F.—while during very hot weather it is not unusual to find cream that has not been run over a cooler, with a temperature of over 80° some considerable time after separation. With a well-designed cooler it is not difficult to get the temperature well below 70°, and in such circumstance gas-forming bacteria are outstripped in their race for existence by the less harmful lactic-acid germs, which eventually crowd out the former.

Acid formed in cream by the lactic-acid bacterium, unless present to such an extent that the acidity is very high, will not affect the grade of the product, providing it is possessed of a good clean flavour, fine texture, and colour, indicating that it has been well looked after and produced under sanitary conditions.

MARTON EXPERIMENTAL AREA.

OPERATIONS FOR SEASON 1922-23.

J. W. DEEM, Fields Instructor.

THE spring of 1922 was very good in the Marton district, and all crops at the experimental area were sown under favourable conditions. Average strikes were obtained, and the prospects for good crops looked bright. The weather, however, broke in December and continued wet right through the autumn, consequently crops did not ripen evenly and harvesting operations were very trying. The cereal crops were saved in fair condition, but later-maturing crops such as peas and tares suffered badly.

OATS MANURIAL TRIAL.

Ten acres of Algerian oats were sown at the end of April, 1922, fed off once in June, and harvested in December. The area was divided into five 2-acre blocks, a different manure being used on each area. Following are the different manurial applications, together with the weights of chaff per acre secured from the different plots :—

Plot 1—1 cwt. superphosphate and ½ cwt. sulphate of potash per acre, 2 tons 4 cwt. chaff; plot 2, half super and half bone char, at 1½ cwt. per acre, 2 tons 7 cwt. chaff; plot 3, half super and half Nauru rock phosphate, at 1½ cwt. per acre, 2 tons 5 cwt. chaff; plot 4, 1½ cwt. Nauru phosphate per acre, 2 tons 10 cwt. chaff; plot 5, 1½ cwt. super per acre, 2 tons 6 cwt. chaff.

It will be noticed that Nauru rock phosphate shows rather the best return, but all the manures gave very even yields.

WHEAT.

Three acres of Major variety were grown, 2 of which were sown on 7th September—1 acre after peas and 1 acre after rape, both the peas and rape having been fed off with sheep; the other acre was sown on 2nd October. Marquis and Yeoman, 1 acre of each, were sown on 7th September. The following table gives yields and dates of harvesting :—

Variety.	Date of Harvesting.	Yield per Acre.
		Bushels.
Major (after peas)	1st February	46·6
Major (after rape)	1st February	42·0
Major (late sown)	12th February	30·0
Marquis	1st February	29·2
Yeoman	1st March	13·3

The following averages have been recorded at the Marton Area: Major, four years, 43¼ bushels; Marquis, three years, 35 bushels; John Brown, three years, 28⅔ bushels per acre.

Yeoman is purely a winter wheat, and as the seed was not received until August it had to be spring-sown. It germinated and stooled out well, but made very little growth until after Christmas, when it grew very fast. In the later stages of its ripening it was the only grain standing in the district, and birds played havoc with it. This accounts for the low yield.

BARLEY.

An area of 3⅓ acres of Black Skinless barley was sown on 6th October and harvested on 21st January. It yielded 26·3 bushels per acre. Owing to the abnormal season even this crop was longer in ripening than usual, and was considerably knocked about.

PEAS.

The three varieties grown were Grey Partridge, Early Minto, and grass-pea. The two former were badly attacked with collar-rot and yielded poorly. The samples were also very poor. The grass-pea was a long time in maturing owing to wet season. At time of writing they have not yet been threshed, as it has been impossible to get the machine on to the ground.

FEEDING-TESTS WITH SUMMER FODDER CROPS.

Four acres of fodder crops were grown, consisting of 1 acre grass-peas and tares, 1 acre Japanese millet, 1 acre Japanese millet and rape mixed, and 1 acre Hickory King maize. These were fed off with sheep and lambs, but owing to the class of stock available (mostly cull Lincolns) the results are of no moment.

HAYING-PASTURE.

Five acres of temporary pasture—Italian rye-grass and red clover in its fifth year—were cut for hay on two occasions. This field was limed with 10 cwt. per acre of carbonate of lime at end of July, 1921, and 1 acre was top-dressed with 2 cwt. per acre of superphosphate in September of the same year. The field, with the exception of that part which received super in 1921, was in August, 1922, divided into plots and top-dressed, part with super and part with Nauru rock phosphate, both at the rate of 2 cwt. per acre, while two small areas were left untouched as controls.

The whole field was closed up on 16th October, 1922, and cut for hay on 2nd January, 1923. During practically the whole time the field was closed the plots which had received superphosphate could be picked out easily, the pasture being of a darker colour than that on the other plots, with much more clover showing. Prior to cutting several average areas were weighed on each plot, the following being the average weights of green material per acre: Plot top-dressed with 2 cwt. superphosphate in September, 1921, 8 tons 7 cwt.; plot top-dressed with 2 cwt. superphosphate in August, 1922, 9 tons; plot top-dressed with 2 cwt. Nauru phosphate in August, 1922, 7 tons 11 cwt.; control area, 7 tons 14 cwt. The average weight per acre of green material over the whole area was 8 tons 3 cwt.

It is interesting to note that this area was sown in temporary pasture in November, 1918, with 25 lb. Italian rye-grass and 5 lb. red clover. Each year since it has been cut for hay, and in addition has grazed on the average two and a half sheep per acre for the whole period. At the end of four years the stand is still fairly strong, both the rye-grass and clover being good. No doubt the rye-grass has done considerable reseeding. The results from this area demonstrate what can be taken from heavy Marton land by careful treatment.

Following are the returns of pressed hay for the past four seasons, also the amount of green material required to make 1 ton of hay: 1919–20—3 tons 10 cwt. hay per acre, 4·3 tons green material to 1 ton hay; 1920–21—3 tons 15 cwt. hay per acre, 4·7 tons green material to 1 ton hay; 1921–22—3 tons 14 cwt. hay per acre, 4 tons green material to 1 ton hay; 1922–23—2 tons 12 cwt. hay per acre, 4·3 tons green material to 1 ton hay (the figures for this season are calculated from green material).

A further area of 11 acres sown with a mixture of 15 lb. Italian rye-grass, 10 lb. perennial rye-grass, and 5 lb. red clover per acre on 6th April, 1921, and top-dressed with several different fertilizers in September, 1921, was closed up on 19th September, 1922, and cut for hay on 8th December. It was then closed up again, and cut a second time at the end of February, 1923. Prior to each cutting average weights were taken, and the following table gives the quantities of green material per acre on the respective plots:—

Top-dressing.	First Cutting.		Second Cutting.		Average.	
	Tons	cwt.	Tons	cwt.	Tons	cwt.
Basic slag at 3 cwt. per acre, on 5/9/21 ..	14	2	10	16	12	9
Nauru rock phosphate at 3 cwt. per acre, on 2/9/21	12	13	8	9	10	11
50-per-cent. phosphate at 3 cwt. per acre, on 13/9/21	13	10	7	12	10	11
Control (not top-dressed)	12	15	8	7	10	11
Average weights per acre over whole field ..	13	5	8	16	..	

LUCERNE.

The lucerne stand of 2 acres was cut three times during the season. Owing to the exceptionally wet season it was not possible to cut this crop on the dates when it was at its best with any degree of certainty of saving the hay. Had the weather been favourable at these times a fourth cutting for the season could have been secured.

As the Marton land is not considered very suitable for lucerne the record of the last three years is interesting, and indicates what can be done on such land if grazing is avoided. A comparison between this lucerne area and the adjoining temporary pasture previously referred to (which was sown the same year) shows that up to the present, and taking into consideration the grazing, the temporary pasture has given the better returns. The results per acre from the older area, sown in December, 1918, are as follows:—

Season.	Broadcast.		7 in. Drills.		14 in. Drills.		21 in. Drills.	
	Tons	cwt.	Tons	cwt.	Tons	cwt.	Tons	cwt.
1920–21	17	0	17	5	17	6	14	14
1921–22 (four cuttings)	25	10	19	14	22	12	21	8
1922–23 (three cuttings) ..	18	15	17	13	17	18	16	13
Average of three seasons ..	20	8	18	4	19	5	17	12

The later area, sown in December, 1919, in 21 in. drills, has given the following results: Grimm variety, with manure, 1921–22, 16 tons 12 cwt.; 1922–23, 14 tons 1 cwt.; average of two seasons, 15 tons 6½ cwt. per acre. Grimm, without manure, 1921–22, 14 tons 12 cwt.; 1922–23, 12 tons; average, 13 tons 6 cwt. per acre. Marlborough variety, with manure, 1921–22, 13 tons 17 cwt.; 1922–23, 13 tons 3 cwt.; average, 13 tons 10 cwt. per acre. Marlborough, without manure, 1921–22, 14 tons 12 cwt.; 1922–23, 11 tons 10 cwt.; average, 13 tons 1 cwt. per acre.

It should be mentioned that it has not been possible to cultivate the lucerne on the Marton Area, the land being either too wet or too hard.

GENERAL.

One acre of grass-peas was grown for seed purposes, but the crop has not yet been threshed.

Tares self-sown in the autumn were fed down twice with sheep during the winter and harvested early in the new year, yielding well. On land like that at Marton autumn sowing of tares should be good practice, for in addition to the benefits of early maturing they provide quite an amount of good sheep-feed.

A further area of 13½ acres has been sown down in temporary pasture for soil-fertility purposes. It is also proposed to sow an area of imported wild white clover when the seed which is on order comes to hand.

Chewings fescue threshed out very well last season, and at the Department's seed-testing station gave higher germination tests than for many years previously.

Compensation for Condemned Stock.—During the last financial year compensation to the amount of £12,986 was paid out for 5,183 animals condemned in the field under the Stock Act, and in addition the sum of £12,657 was paid for carcases or parts of carcases condemned on inspection at time of slaughter under the provisions of the Slaughtering and Inspection Act, making the total amount for which the Consolidated Fund became liable £25,643.

Nauru Phosphate.—Since the acquisition of the Nauru and Ocean Island phosphate-deposits by Britain, Australia, and New Zealand the importation of phosphate-rock from that source into this Dominion has been in the hands of the Department of Agriculture. The business having become well established, with the Dominion now absorbing its full quota, arrangements were made for its conduct to be placed in the hands of the Phosphate Commission as from 30th June last. The arrangement between the Department and the commercial agents terminated at the same time, the agents now acting for the Commissioners only.

TESTING OF PUREBRED DAIRY COWS.

MAY–AUGUST C.O.R. LIST.

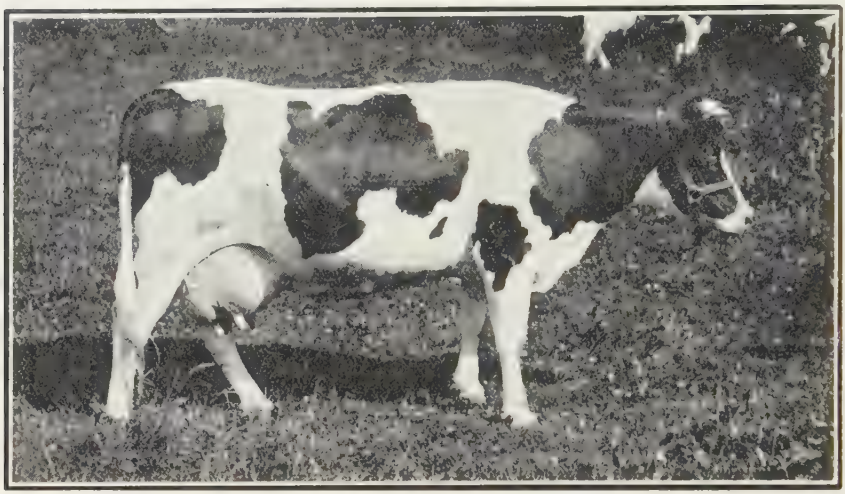
Dairy Division.

THE following list comprises the records of cows which received certificates during the four months May to August, 1923. It will be seen that several noteworthy records have been made, apart from that of Hilda Minto de Kol previously noticed in the *Journal*.

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		JERSEYS.				
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Alfalfa Cicero Fontaine	F. J. Saxby, Ohaupo..	2 69	247·4	365	11,238·4	665·74
Lola	Mrs. E. M. Spinley, Palmerston North	2 91	249·6	365	8,356·2	520·64
Viola's Lady Mercedes	H. C. Sampson, New Plymouth	1 302	240·5	365	7,273·9	457·90
Bridge View Duchess	A. L. Hooper, Mahoe..	1 260	240·5	365	7,383·9	432·99
Larking	R. Hicks, Hawera ..	2 16	242·1	311	6,900·7	427·83
Pelynn Daisy ..	L. K. Tarrant, Ngaere	2 24	240·9	310	6,369·2	421·77
Silverdale Magnet ..	G. Hodgson, Whakapara	1 204	240·5	365	6,510·1	410·92
Signor's Lilac ..	G. Buchanan, Paeroa	2 11	241·6	325	7,597·3	404·21
Spring Meadows Lavender	D. M. Finnie, Westmere	1 288	240·5	365	7,173·5	380·24
Rosy Creek Gaillardia	A. L. Hooper, Mahoe	1 307	240·5	330	6,916·2	379·86
Burnside Golden Chimes	S. J. Hollard, Rowan	2 4	240·9	317	7,354·0	353·13
Elfin Grange Dairymaid	E. S. Walker, Stratford	1 360	240·5	327	6,494·7	347·31
Oakleaf	R. Hicks, Hawera ..	1 307	240·5	327	6,530·7	345·84
Sweet Lass ..	H. T. Mellow, Stratford	2 25	243·0	292	5,555·3	335·18
Miro Meadows Tulip	A. A. Ward, Tariki ..	1 324	240·5	330	5,536·0	311·76
Meadowvale Petrova	S. J. Robinson, Hinuera	2 24	242·9	303	5,389·0	303·59
Rawhitiroa Leafless	H. M. May, Hukerenui	2 3	240·8	273	5,803·2	302·04
Rawhitiroa Cushla ..	H. M. May, Hukerenui	2 7	241·2	263	5,150·7	290·56
Senior Two-year-old.						
Kuku Lily.. ..	R. L. Horn, Ohau ..	2 325	273·0	349	11,747·7	603·20
Roslyn Genoa Fox ..	J. Harris, Bombay ..	2 273	267·8	365	9,278·9	517·55
Joyful's Joybells ..	J. G. Robertson, Eltham	2 164	256·9	365	8,638·9	497·30
Nanny	A. E. Phillips, Maunu	2 291	269·6	327	8,824·5	493·69
Holly Oak's Fairy ..	M. V. Reeve-Smith, Aria	2 119	252·4	365	8,129·6	478·58
Netley Girl ..	J. Nicholson, Manakau	2 285	269·0	357	8,313·8	445·93
Maori Pulchra ..	A. G. Somervell, Takapau	2 234	263·9	365	6,121·1	406·56
Delectation ..	G. Buchanan, Paeroa	2 291	269·6	365	7,573·0	404·10
Holly Oak's Alma ..	W. P. Begg, Arapohue	2 130	253·5	311	5,848·5	380·70
Rosetree's Miracle ..	W. Glaister, Te Kuiti	2 340	274·5	320	5,364·5	355·85
Swansea Myrtle ..	S. Atkinson, Papatoetoe	2 313	271·8	276	5,274·7	293·69

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS—*continued.*						
Three-year-old.		Yrs. dys.	lb.		lb.	lb.
La Corsica	F. J. Saxby, Ohaupo	3 115	288·5	356	8,699·1	525·07
Mira	T. M. Remington, Westmere	3 341	274·6	351	7,774·8	485·65
Hawkesbury Butterfly	A Buchanan, Palmerston North	3 267	303·7	308	8,275·0	460·01
Mangaoraka Princess	E S. Walker, Stratford	3 352	312·2	323	8,098·9	457·31
Vaultress	G. E. Cowling, Manaia	3 346	311·6	326	7,405·9	451·46
Gleam's Eden ..	S. Atkinson, Papatoetoe	3 33	280·3	293	6,276·8	397·34
Hawkesbury Graceful	A. Buchanan, Palmerston North	3 213	298·3	285	5,689·6	339·55
Hillsbourne Picotee ..	A. Buchanan, Palmerston North	3 193	296·3	363	5,804·3	334·18
General's Lady ..	E. H. Linnell, Midhirst	3 346	311·6	313	5,816·6	316·65
Eileen's Betty ..	S. Atkinson, Papatoetoe	3 324	309·4	310	5,453·7	315·20
Four-year-old.						
Berenice	R. Haylock, Stratford	4 2	313·7	365	9,358·0	577·00
Kuku Lilyvale ..	R. L. Horn, Ohau ..	4 314	344·9	257	11,089·4	576·15
Reid Park's Maiden	R. F. Wilkinson, Pukekohe	4 255	339·0	341	10,151·4	534·85
Roslyn Pearl ..	J. Harris, Bombay ..	4 210	334·5	281	7,080·2	436·81
Ventricosa	G. A Gamman, Marton	4 271	340·6	296	6,471·9	378·16
Mature.						
Regal of Jersey Meadows	H. H. Phillips, Dannevirke	5 272	350·0	365	10,780·8	547·77
Charm's Mayflower ..	G. Buchanan, Paeroa	6 295	350·0	322	9,401·5	496·99
British Maid of O.K.	E. S. Walker, Stratford	5 357	350·0	309	10,803·8	479·21
Sunstorm	F. J. B. Ryburn, Paterangi	5 55	350·0	308	8,720·4	469·17
Swan Cup	J. Harris, Bombay ..	6 255	350·0	365	7,561·6	434·84
Kuku's Sis ..	R. L. Horn, Ohau ..	6 356	350·0	287	8,583·5	420·53
Record of Bulls ..	G. A. Gamman, Marton	6 356	350·0	319	7,004·4	409·23
Nora's Garnet ..	A. C. Mannington, Maungatapere	7 38	350·0	275	7,655·0	372·84
Treasure's Lass ..	C. B. Herrold, Waiuku	8 11	350·0	349	6,416·2	368·73
FRIESIANS.						
Junior Two-year-old.						
Queen Mercena Posch	N. P. Nielsen, Tiakitahuna	1 233	240·5	365	12,199·4	425·95
Fencourt Lady ..	J. H. Jamieson, Cambridge	1 341	240·5	264	8,427·8	314·28
Anawhata Hengerveld de Bonte	P. F. Boucher, Kumeu	2 99	250·4	313	7,060·7	260·22
Senior Two-year-old.						
Pietertje Dutchland Abbekerk	H. R. Green, Kairanga	2 318	272·3	353	19,164·0	675·21
Bainfield Tirania 2nd	W. D. Hunt, Invercargill	2 332	273·7	365	13,972·9	555·30
Cordyline Blanche ..	G. Aitchison, Kaitangata	2 210	261·5	365	15,248·5	553·89



ROSEVALE QUEEN DAPHNE (H. NORTH AND SONS, OMIMI).

C.O R., 1923, Friesian Junior Four-year-old Class: 20,050·31 lb. milk, 805·54 lb. butterfat, in 365 days.

DELILAH (JAMES NICHOLSON, MANAKAU).

C.O.R., Jersey Three-year-old Class: 10,916·35 lb. milk, 641·19 lb. butterfat, in 365 days.

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd. for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
		FRIESIANS—*continued.*				
Senior Two-year-old—continued.		Yrs. dys.	lb.		lb.	lb.
Brookdale Johanna Canterbury	S. Knight and Sons, Ongarue	2 209	261·4	365	13,218·5	508·25
Tokaora Galatea Segis	R. H. Hammond, Ohakune	2 270	267·5	285	12,866·8	425·86
Senior Three-year-old.						
Woodlyn Grace Champion	T. C. Barbour, East Tamaki	3 347	311·7	361	18,596·6	570·67
Woodlyn Lady Burke de Kol	T. C. Barbour, East Tamaki	3 222	299·2	365	16,223·8	542·81
Junior Four-year-old.						
Monavale Aurora Pietertje	S. Knight and Sons, Ongarue	4 62	319·7	365	14,401·7	548·85
Senior Four-year-old.						
Cluny Netherland Colantha 8th	Piri Land Company, Auckland	4 333	346·8	365	21,465·7	755·24
Rosevale Burkeyje Sylvia	H. North and Sons, Omimi	4 287	342·2	365	17,834·8	703·82
Colinton Betty	R. Colee, Greendale ..	4 318	345·3	365	14,495·4	477·57
Mature.						
Hilda Minto de Kol ..	C. H. Steadman, Kamo	12 56	350·0	365	27,773·8	1046·31
Rosevale Sylvia Keyes	H. North and Sons, Omimi	5 11	350·0	365	25,344·0	777·23
Lakeview Lotta ..	H. R. Green, Kairanga	6 330	350·0	312	18,966·7	588·32
Waituki Princess Viola Burke	T. C. Barbour, East Tamaki	5 254	350·0	365	14,613·8	567·00
Nancy Lee 2nd ..	Frank Ducker, Opotiki	9 282	350·0	334	12,085·4	406·88
		MILKING SHORTHORNS.				
Junior Two-year-old.						
Pine Farm Daisy 2B	J. Parkinson, Opotiki	2 176	258·1	365	12,584·1	455·33
Mature.						
Ingleburn Duchess ..	J. Pease, Matatoki ..	10 64	350·0	365	12,640·0	472·83
		AYRSHIRE.				
Two-year-old.						
Maesgwyn Moonlight	C. Morgan Williams, Ohoka	2 162	256·7	365	8,692·3	336·23

Second-class Certificates.

		JERSEY.				
Mature.						
Geraldine	C. Stevens, Maungatapere	6 186	350·0	365	8,601·6	520·32
		FRIESIAN.				
Junior Two-year-old.						
Bainfield Topsy 10th	W. D. Hunt, Invercargill	1 356	240·5	365	15,162·5	567·88

CARROTS FOR SHEEP-FEEDING.

In the *Journal* for November, 1917 (page 277), the writer referred to carrots as a field-crop for sheep-feeding. Since then, owing to the increasing difficulty of growing swedes free of disease, carrot-growing for sheep has considerably extended in the Wanganui–Taranaki coastal areas. On a farm near Waverley this year 7 acres of a 13-acre field carried 800 breeding-ewes for six weeks, and did them well. Several field-crops have been weighed and have given yields of from 36 to 45 tons per acre. The Guerande carrot mentioned in the previous note is still considered the best for sheep-feeding.

Several methods of growing have been tested, but the one which appears to give the best results is sowing on ridges 21 in. to 26 in. apart, with seed at the rate of 1 lb. per acre. Thinning is not necessary, but the carrots should be intercultivated a few times by means of the horse-hoe to keep the land free and control weeds. With drills anywhere between 21 in. and 26 in. apart the cultivation is easy. Thinning has been tried, but so long as weeds are controlled it is not considered advisable. These carrots may also be sown on the flat through every coulter of the drill, seeding at the rate of 2 lb. per acre. The ridge method is the best, however, the crop being easier to clean and feed off.

Farmers who find it difficult to grow swedes and have suitable land for carrots are confidently recommended to give the latter a trial. They should be sown from the middle of November to early December.

—*J. W. Deem, Fields Instructor.*

PROTECTION OF NATURAL ENEMY OF THE RABBIT.

By an Order in Council under section 25 of the Rabbit Nuisance Act, 1908, dated 20th August, stoats and weasels are declared to be natural enemies of the rabbit, and the killing or capturing of such animals is prohibited without a special permit signed by an Inspector.

In regard to this Order, it is notified for public information that—(1) In districts which are free from rabbits consideration will be given to the granting of an exemption from the general protection upon receipt of a petition in that behalf made by any local authority or acclimatization society in accordance with the provisions of section 25 of the Rabbit Nuisance Act, 1908; (2) Inspectors of Stock have been authorized to issue permits for the destruction of stoats and weasels on (*a*) island sanctuaries; (*b*) acclimatization societies' game-rearing farms: and (*c*) poultry-farms where it is established that damage is being done on such farms by these animals.

IMPORTATION OF ANIMALS INTO AUSTRALIA.

The several Commonwealth Proclamations governing the importation of animals into Australia have been modified and consolidated as from July last. Importation from New Zealand is permitted of horses, mules, asses, cattle, sheep, swine, goats, dogs, and cats, subject to the general provision requiring certificates and declarations to be furnished in accordance with the quarantine regulations.

SEASONAL NOTES.

THE FARM.

PASTURES.

PASTURES will now be making good growth, and every care should be taken to feed them as evenly as possible so as to prevent their getting away. There is nothing like a well-grazed clean pasture to produce butterfat or fatten stock. If droppings have been allowed to accumulate the tripod or chain harrows should be used to scatter them. On farms devoted partly to dairying and partly to the pasturage of sheep, paddocks on which ewes are to be turned with their lambs should be heavily stocked with cattle during October, in order to prevent too rank a growth of grass in November and December, as, if this occurs, scouring will result in the ewes, and the number of lambs fattened off their mothers will consequently be reduced.

Paddocks intended for hay should be shut up about the middle of October. Where possible the haying of permanent pastures should be avoided. It is preferable to hay short-rotation pastures consisting of perennial rye- and cow-grass where such pastures exist. Owing to the saturated state of the subsoil this year such grass-sowings may be confidently made in October.

When sowing down pastures in general at this season of the year it is good practice to drill either 1 lb. of rape or Buda kale, then roll the land again and sow the grass-seed, covering the latter with light tine or brush harrows. The rape or kale supplies some quick feed and shelters the young grass.

SUMMER FORAGE CROPS.

Land intended for mangolds, carrots, soft turnips, kale, cereals and vetches, &c., should be well worked in preparation for sowing towards the end of October or early in November. Generally speaking, the first week in November is early enough, but in the warmer situations these crops may be sown any time after the middle of October. On farms where club-root and dry-rot have been bad during the preceding season an endeavour should be made to arrange for sowing brassicas on land which has not been under that class of crop for a number of years.

Good varieties of soft turnips are Red Paragon, Lincolnshire Red Globe, Hardy Green Globe, and Imperial Green Globe. Where they are required for feeding to cows it is best to sow a small area first, and more in about two or three weeks. On a properly prepared seed-bed 8 oz. to 10 oz. of seed per acre is ample. Suitable manures are basic super, or mixtures of two parts of super and one of Ephos phosphate, basic slag, or Nauru rock phosphate, at from 2 cwt. to 3 cwt. per acre. Sow through every second coulter of the drill or on ridges. For early crops of turnips it is worth while to steep the seed in turpentine before sowing, with a view to preventing the attack of the fly or beetle.

If rape is cropped after grass on good land 3 cwt. of super and Nauru rock (half-and-half) gives good results. On poorer land, or where the rape follows a cereal crop, one of the freezing-works mixtures containing 2 to 3 per cent. of insoluble nitrogen is probably preferable. Rape has a heating effect on lambs, and the headland and a few strips across the paddock should be sown in mustard just after the rape is up in two rough leaves, so that the two crops mature at the same time.

MANGOLDS AND THEIR CULTIVATION.

Provided they have a chance to become well rooted before dry summer weather arrives, mangolds often do quite well in dry seasons when the swede crop is a failure. Prizewinner, Jersey Queen, White Sugar, and Red Intermediate

are among the best varieties. Where a fair area is being put down it is advisable to sow two or more varieties so that the stock will have a change; there are also slight variations in the ripening-period.

For small areas mangolds may be sown in drills 14 in. to 21 in. apart and hand-hoed, but for anything over ½ acre the drills should be from 22 in. to 28 in. apart, so as to permit the intercultivation being done by means of the horse-hoe. Mangolds require a good free soil, and may either be drilled on the flat or put in with the ridger. The latter method allows a better distribution of manure, and the crop is easier to clean. The seeding should be at from 4 lb. to 6 lb. per acre.

Manuring should be generous, not less than 3 cwt., but generally from 4 cwt. to 6 cwt. will be found profitable. Mangolds like a complete manure, and for this reason special mangold-manures are very suitable—mixtures of half super and half Ephos, bonemeal, or Nauru; or three parts super and two parts bone, Ephos, or Nauru. Sulphate of potash, at ½ cwt. per acre, added to these is an advantage. Salt is also very beneficial, especially in situations a fair distance from the sea. This should be broadcasted at the rate of 3 cwt. per acre, and harrowed a day or two before the crop is sown. In place of the sulphate of potash and salt, kainit may be used at from 2 cwt. to 3 cwt. per acre; it supplies both salt and potash.

CARROTS.

Carrots make a valuable forage crop for milking-cows in the late autumn and early winter; while for hard-fed horses a few each day when the grass is scarce are an excellent dietetic. Their suitability for sheep-feeding is dealt with in a special note elsewhere in this issue. The crop does best in a deep, sandy loam, with a free subsoil. Matchless White, Sinclair Champion, and White Belgian are good varieties for field purposes, being heavy yielders and easily lifted.

Where the area grown is not large the seed may be sown in drills 14 in. apart, and the rows hand-cultivated; this system generally gives the heaviest crop per acre. On the other hand, if the area is fairly large the sowing should be in drills 21 in. to 28 in. apart, with subsequent horse-cultivation. If properly worked, nearly as heavy a crop can be grown this way, and the labour is greatly reduced. For the wider drills sow at the rate of 1 lb. per acre, and for the 14 in. rows 1½ lb.

Where great difficulty is experienced in growing swedes, owing to club-root and dry-rot, carrots should certainly be given a trial.

MAIZE-GROWING.

In districts where maize is grown for cob-production preparation of the land should now be well in hand. Maize is expected to make abundant growth during a comparatively short period, and the initial cultivation should be both deep and thorough. Under suitable climatic conditions the crop will thrive on a wide range of soils, but land that is cold or badly drained should never be selected.

Seed should have been chosen last autumn from the standing crop just before harvest, and careful selection is amply repaid by the increased yield resulting. About sixteen average cobs, or 15 lb. to 20 lb. of seed, are sufficient to sow an acre, the plants being about 10 in. apart in 3 ft. 6 in. rows. This will give the crop sun and air—all-important factors. October and November are generally the favoured months for planting. The seed should be set about 1½ in. deep, and manure used according to the fertility of the land. Generally speaking, 1½ cwt. to 3 cwt. of a mixture of super and blood-and-bone will give profitable results.

Thorough cultivation during the growing season is of prime importance, in order that weeds may be kept down and a good soil-mulch maintained, thus ensuring the steady growth of the crop. Constant use of the horse-hoe will be well repaid, however clean the land may appear to be.

CEREALS.

The fine weather experienced this month (September) has enabled farmers to sow wheat where spring sowing can safely be practised. Oats should not be sown later than October, and barley-sowing should also be completed then. Autumn-sown wheat should now be rolled and harrowed.

Barley, being a surface feeder, naturally prefers a light soil of a sandy and calcareous nature. Although it does best after a root crop, it can be grown anywhere in the rotation, and should receive the same cultivation as that given to the oat crop. As maltsters desire a fairly large uniform quantity of grain with even germinating-capacity, it is desirable that the growers in each district should endeavour to crop the same variety. In Marlborough varieties of malting barley of the Chevalier type are most commonly sown in October on the heavier lands—those of the Wairau Plain. The Gisborne variety is usually autumn-sown in the drier country of the Awatere Valley. In the Hawea and other inland districts of Otago where barley-growing plays an important part in the farm operations it may be sown right up till the end of October. A variety named New Binder has given excellent results and is well worthy of extended trial.

POTATOES.

From the beginning of October onward the second early and main crop of potatoes may be planted, care being taken that the ground is sufficiently worked to be free from weeds. From 10 cwt. to 15 cwt. of seed should be sown in 28 in. rows to allow of intercultivation with horse-drawn implements. Good moulding-up tends to prevent the ravages of potato-blight and to ensure heavier crops. A manurial mixture consisting of 3 cwt. super, ½ cwt. sulphate of potash, and ¼ cwt. sulphate of ammonia generally gives good results.

Only the best of seed should be used. Many selections of the chief varieties of main croppers go under various names. Among the good standard varieties are Up-to-date, El Dorado, Arran Chief, King Edward, Maori Chief, Gamekeeper, and Northern Star. The last three varieties are more or less immune from blight.

In favourable situations and circumstances a few acres of potatoes make a very valuable cash crop on a small dairy farm, and help materially to increase the net returns. For domestic use it is a good plan to plant a few drills of potatoes in the mangold-field, as the two crops are sown and mature about the same time.

PULSE CROPS.

Peas should be sown during October. In Canterbury there were indications during last season that the regulation seeding of one sack to the acre was too heavy. Cases of lighter seedings which resulted in good yields have been brought to notice. In Marlborough, Dwarf, Medium Straw, Partridge, Prussian Blue, and other varieties should be sown not later than the second week of the month. About 3 bushels per acre of the Dwarf and Medium Straw varieties, and 2½ bushels of Partridge and Prussian Blue (smaller peas), are sown. Owing to collar-rot, pea land in Marlborough should generally be limed; superphosphate should not be used alone.

LINSEED.

Land should be prepared for this crop where grown, and it may be sown towards the end of October at the rate of 30 lb. to 35 lb. per acre.

LUCERNE.

Most lucerne stands will now be shut up for a crop. Where necessary the stand may still be top-dressed with superphosphate at the rate of 2 cwt. per acre. In Marlborough, owing to fine weather conditions, it is sometimes possible to get a cut of lucerne hay in October. This, however, is not possible in most districts. Ensilage may be made, or the lucerne cut and fed out in a neighbouring paddock. In this way much of the nutrient matter is returned to the ground in the droppings from the stock.

Under Canterbury conditions, where late frosts are a frequent occurrence, sowings of lucerne should not be made before the end of October, except in cases where the soil is extremely light and the crop is likely to be damaged by the hot drying winds sometimes experienced in early summer. The sowing season may be extended until the beginning of March. It should be remembered, however, that October seeding is advisable only where the land is thoroughly clean and where there is no risk of weeds getting away with the young crop. Spring sowing certainly has the advantage of enabling the young plants to escape grass-grub attack.

—Fields Division.

SANITARY PRECAUTIONS AT SHEARING-TIME.

Blood-poisoning among sheep at shearing-time is still too prevalent, and calls for the close attention of farmers. After a thorough clearing-out of the shed the first consideration is absolute cleanliness of the shearing-board and counting-out pens. The floor and walls should be thoroughly scrubbed with a disinfectant before and immediately after shearing. The counting-out pens should be swept clean and liberally sprayed with disinfectant, and afterwards a small quantity of unslaked lime spread on the pens.

The shearers' water-pots for cooling shears or machines are a likely source of infection. They should be cleansed with disinfectant, and when refilled with water a small quantity of kerosene should be added. The reason for this is that the kerosene floats on the surface, so that every time the shears are withdrawn a coating of kerosene adheres to the shears and acts as a very good disinfectant.

Much the most common cause of blood-poisoning is the entrance of germs through small wounds—wounds which are very often unnoticed by the shearer. As soon as these small wounds are covered over with scurf or matted wool the germs of blood-poisoning immediately become active. A sharp lookout should be kept, and, no matter how small the wound, each should be dressed with Stockholm or Archangel tar, which should be kept handy in a receptacle for the purpose. All excreta are hotbeds of bacteria, especially from such animals as pigs, fowls, or dogs, and the quartering of such animals in or near a shearing-shed should be carefully avoided. The excreta when dry are blown about by wind, and often deposited in the counting-out pens and even on to the shearing-board, or on to the fresh wounds while the sheep are held for counting and branding.

—F. Mackenzie, Live-stock Division.

THE ORCHARD.

SEASONAL SPRAYING.

DURING this season of the year the new growth of trees is at the tenderest stage of development, which condition, combined with the moist to humid weather generally prevailing, renders the trees very susceptible to the various fungus diseases which become active at the same period. The hope of success with the coming season's crop depends in a great measure on the precautions taken to guard the developing growth from attack not only by fungus diseases, but also by the insect pests which abound at this season of the year.

The tender state of the trees necessitates the exercising of great care in the use of sprays in order to avoid damage to the foliage and promising crop, but, on the other hand, the prompt use of a suitable spray is the best safeguard against attack or infection. Under no reasonable circumstances should such a spray be neglected, as it becomes almost impossible to later regain the control over diseases which have become established

Peaches, nectarines, and Japanese plums should be sprayed with lime-sulphur, 1–125, plus 6 lb. atomic sulphur. The addition of atomic sulphur to the usual lime-sulphur spray is well worth while, as wherever tried it has increased efficiency in the control of brown-rot. Black aphis may be expected on this class of trees, and should it appear Black Leaf 40, 1–800, may be added to the above spray. Where there are a few isolated bad colonies it is wise to cut out the infected parts as an additional precaution. English plums are somewhat later in showing growth. Bordeaux mixture, 6–4–50, should be used at the tight-cluster stage as a special precaution against rust. Too often these trees are missed with the spring bordeaux, as they are somewhat out of time with the other stone-fruits.

Seasonable spraying for pears will be bordeaux, 6–4–50, at tight-cluster, followed by a further application at 3–4–40 at pink-cluster, as late as possible before the bloom opens. In districts where black-spot is not prevalent, or on varieties not prone to this disease, lime-sulphur, 1–25 and 1–80, may be substituted at the same periods.

As the price received for good quinces is, in the main, more remunerative than that for mid-season apples and pears, it is difficult to understand the general

lack of attention to these trees. Many at present semi-neglected trees could, with a little extra care, be made much more profitable. Spraying as for pears will materially assist towards this end.

For apples the tight-cluster spray of bordeaux, 6–4–50, is the foundation spray against black-spot. A further spray is then necessary about open or pink cluster. This should be lime-sulphur, 1 80, on varieties least susceptible to spot, and bordeaux, 3 4 40, on others. It is at this stage that the greater part of the russet is caused; therefore bordeaux should not be used except where spot is anticipated. A word of warning is also necessary in regard to the use of lime-sulphur at this stage, as when it is applied on Delicious, Lord Suffield, and Ribston Pippin there is a tendency for these varieties to shed the fruit.

When the petals have fallen (calyx stage), apples and pears should be sprayed with arsenate of lead, 2 lb., plus lime-sulphur, 1 gallon to 100 gallons of water to which the milk of 2 lb. freshly slaked lime has been added. While some orchardists argue that this calyx spray is not necessary for the control of codlin-moth, its application should not be omitted, as there are various other biting and chewing insects to be considered, and if these are controlled at this stage better fruit results.

ELIMINATING LOW-GRADE FRUIT.

There can be no two opinions about the detrimental effect low-grade fruit has on the markets, and the desirability of keeping the latter as free as possible of this class of produce. There is a variety of opinion as to how this may best be accomplished, but the surest method is to eliminate the production of such fruit.

After the experience of the past season it behoves every orchardist to make a special effort to reduce to a minimum the production of "culls." This is the season of the year when the majority of the culls are made—bad weather conditions or faulty spraying allowing black-spot and other diseases to get hold; wrong mixture or wrong time of application causing russet; neglect of insecticide permitting insects to injure the fruit and cause blemish; lack of attention to thinning resulting in deformed and undersized fruit; overcropping causing malnutrition; and lack of cultivation inducing shortage of summer moisture. The foundation of at least three-quarters of the faults in cull fruit is laid at this season, which is the most opportune time for checking the factors causing defects in the crop.

CULTIVATION, GRAFTING, AND THINNING.

Where spring ploughing has been delayed the work should be undertaken at once, and the land so turned over worked down with as little delay as possible. Continue the cultivation of ploughed land and endeavour to secure a good tilth.

Grafting may be done as the sap rises and the bark moves freely on the stocks to be worked over.

Some of the earlier varieties of peaches will have attained a fair size by the end of the month, and a start may be made to reduce the number of fruits carried. This work should be undertaken very cautiously until the fruit has proved fertile by the development of the pit. As a preliminary to thinning of pip-fruits the flowers should be pinched or cut away from the tops of the leader growth. All the bloom should be removed from one-year-old wood in any case, and may with advantage be removed from two-year-old wood on leaders of trees which are weak in habit or health.

—*W. H. Rice, Orchard Instructor, Hastings.*

CITRUS FRUITS.

In cases where spring work in the citrus orchard has not yet been undertaken this should be immediately put in hand. Manuring, digging, and ploughing should be carried out at the earliest possible date, followed by early spraying with bordeaux, 4–4–40, when the majority of the blossom-petals have fallen after the main flowering. In regard to manuring, an application of two parts of blood-and-bone to one part of super is recommended. The addition of a small percentage of potash will also be found beneficial in most instances.

FIREBLIGHT.

It is noticed that there is a considerable lack of interest taken by some growers in regard to the proper disposal of prunings taken from pip-fruit trees.

While the menace of fireblight is still on hand, no risk should be taken in this regard; all prunings should be carefully collected and destroyed by burning, in preference to the practice adopted by many orchardists of placing the prunings in or under the shelter-belts adjacent to the orchard. This is always dangerous, from many points of view, and should be avoided.

—*J. W. Collard, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

CARE OF THE YOUNG STOCK.

It may be reiterated that if only profitable stock are to be reared all chickens should be hatched out during the next two weeks at the latest. Chickens brought out later will never return even a fair profit over their keep. Present indications are that foodstuffs, particularly wheat and its by-products, will reach a high level of value by the time this season's stock reach a productive stage. This, together with the fact that the average price of eggs has been gradually declining, is sufficient to indicate that the present aim of poultry-keepers should be to secure quality of stock rather than numbers alone. It should never be forgotten that a better return will always be secured from a small flock of early-hatched birds than from a large number late-hatched.

Not only must the chickens be hatched early, but in addition they should be given every opportunity to make healthy development. This implies liberal feeding from first to last. Plenty of good grain is necessary, but an ample supply of succulent green stuff is of equal importance; indeed, young stock will never thrive to the best advantage unless this is provided with a free hand.

Before the chickens are removed from the brooder every care should be taken to make the houses fit to receive the young birds. Where the quarters intended for the chickens have recently been occupied by adult stock they should be thoroughly cleaned and sprayed with a good disinfectant, as there are few houses that are quite free from vermin. Do not allow the chickens to huddle in the corners of the house when first removed from the brooder, or the mortality may be great. The corners should be rounded off with fine-mesh wire netting. In addition, a temporary hover made of sacking or similar material should be provided for the chickens to sleep under. This will give them the seclusion which they naturally look for after leaving a closed-in brooder; but at the same time it must be arranged in such a way that the birds can secure an ample supply of fresh air.

The chickens should not be allowed to sleep on a hard floor, as this is apt to cause crooked breast-bones; the floor should be well bedded down with perfectly dry straw. Grass hay should never be used for this purpose, as it is apt to heat and bring on a sweated condition of the chickens, with serious results. The chief trouble caused in this way is an inflammation of the veins. It first makes its appearance in the hock-joints, which become discoloured; then a gangrenous swelling follows; in a few days the wings become affected in a similar manner, and later the neck and head swell. At this stage death is not far off. There is no cure for this trouble; it is merely a question of prevention. Do not overcrowd; provide ample ventilation; keep the floors clean and dry; and check everything that tends to create a moist atmosphere. Wherever possible a piece of fresh ground should be provided for the growing stock. This is one of the secrets for their sound development.

Do not allow chicks of different ages to run together. Some people even go so far as to allow the young birds to run with the adult stock. This is a serious mistake. It is useless taking every care of the chicks during the brooder stage and then placing them at such a disadvantage. Few old birds are quite free from vermin. Incubator chicks, if given careful management, should go right on to maturity without having to fight parasitic life; but exposing them to probable vermin infection by forcing them to run with old stock and on stale ground is obviously all against their attaining desired size and sound constitutional vigour. No care and attention is too good for the growing birds.

GIZZARD TROUBLE IN WHITE LEGHORNS: A WARNING.

Whether or not the flocks of many poultry-keepers are on the down-grade so far as constitutional vigour and digestive power are concerned is difficult to say. The fact remains, however, that in too many cases flocks of the popular White Leghorn breed are becoming more weedy than ever before. Although actual disease is not on the increase (except perhaps in the case of tuberculosis), there are other troubles which have increased to a somewhat alarming extent in recent years. For example, scarcely a day passes but cases are reported of birds dropping dead at feeding time from no apparent cause—birds which in most cases are in a heavily productive condition. It is safe to say that for every complaint received a few years ago regarding this trouble there are a hundred now.

The writer has made many post-mortem examinations in investigating this mortality. In almost every case the heart was found to be in a badly ruptured condition, and the gizzard packed with fibrous material, such as pieces of grass, oat-husks, &c. Obviously, the ruptured heart was the sole cause of death, but here the question arises, What caused the heart to rupture? The writer is of the opinion that this was entirely due to the gizzard being compacted with fibrous material, causing derangement of the digestive system. The excitement at feeding-time caused an excessive blood-pressure, and consequently a ruptured heart. A further question which presents itself for consideration is, What causes gizzard-compaction? It may be said that this is due to lack of proper grit, but this opinion is discounted by the fact that in many cases post-mortem examinations have disclosed that the gizzards contain plenty of grit. In some affected flocks it was observed that when all fibrous matter, such as oats, were eliminated from the ration the mortality ceased. Here another question presents itself for consideration. In view of the fact that many breeders daily feed their birds on oats with no injurious results, it appears that when mortality takes place from this trouble, as previously outlined, its chief cause is a constitutional weakness and lack of digestive power, probably brought about by sacrificing everything for egg-yield.

Once this trouble makes its appearance in a flock the only safe course is to withhold from the ration as far as possible any fibrous material such as oats, grass, lucerne, &c. Finely chaffed succulent green stuff should be provided in abundance. If this is not available, root crops such as turnips, mangolds, &c., should be provided for the birds to pick at. In addition, see that plenty of sharp gravel grit is within reach at all times. In this way the birds are given an opportunity to free themselves from any fibrous matter that may be contained in the gizzard. This, however, is merely a temporary expedient.

If the stock are to be permanently free from this and other troubles which affect poultry, breeders must realize, and at once, that if everything is sacrificed for egg-production disaster must follow. The danger of improving one character by weakening another should always be kept in mind, and while aiming for high egg-records care should be taken that constitutional vigour—the foundation of all successful breeding operations—is not lost in the process. The warning is here, and breeders should heed the lesson that egg-record is not everything in the maintenance of payable flocks. However well a fowl may lay, if she does not possess the desired constitutional points she should not be bred from. Strange to say, the writer has not had one complaint regarding the trouble in other than the White Leghorn breed.

SOFT-SHELLED EGGS.

Now that the birds are laying at the height of their capacity, soft-shelled or shell-less eggs are apt to be produced. These not only mean a direct loss, but they also encourage the birds to acquire the habit of egg-eating. Such eggs are easily broken, and once the hens have tasted the substance it will probably not be long before they learn to break the shells of the sound eggs for themselves. Soft-shelled or shell-less eggs are mostly caused through lack of shell-forming material, or through the birds being overforced with rich food such as meat, meat-meal, condiments, &c., while sometimes the trouble is due to the fowls being overfat and their reproductive organs not functioning normally.

A liberal supply of crushed oyster-shell or burnt bone, together with ample provision for the birds to exercise, will help to correct matters in this respect. As to condiments, these should never be fed to a laying flock. They may stimulate the egg-producing organs, but as a general rule the effect is brief, and the reaction

which sets in not only defeats the end in view but also tends to cause ovarian troubles, possibly resulting in a complete breakdown and subsequent death. The best testimony we have of the futility of condiments for consistently stimulating egg-production is that the high records obtained at the egg-laying competitions are established without their aid.

—*F. C. Brown, Chief Poultry Instructor.*

THE APIARY.

SEASONAL PREPARATIONS.

OCTOBER is perhaps the month when the apiarist can do most in helping his bees to work up to full strength in time for the main honey-flow. In the warmer parts of the country swarms may be looked for about the middle of the month, but in the southern districts they will probably not appear until three or four weeks later. By 1st October, unless the weather for some weeks has been cold and wet, every hive should have been examined and its condition noted with regard to stores, population, and health.

No colony should be allowed to dwindle because it has not sufficient food to provide for the offspring of a prolific queen. Yet, on the other hand, some beekeepers prefer that all the old honey in the hive should be used up before the new season's flow commences. The food-supply of the hive is sometimes an exceedingly puzzling matter, as it varies considerably in accordance with the weather and the strength of the colony, and only periodical and systematic examinations can settle the question as to whether all is well with the hives in this respect. No harm can be done by feeding good white-sugar syrup, but a hive which is starved in the spring will probably not recover its strength till the main honey-flow is nearly over. By the middle of October, under normal weather conditions, every hive should have at least four frames of sealed brood, and many will have more. Those that have fewer, unless their food-supply is very short, should be marked for requeening as soon as possible. The apiarist's endeavour should be to keep his colonies as even as possible, thereby obtaining a uniform surplus throughout the apiary.

Wherever there is a fair yield of nectar from spring flowers the beekeeper would do well to take advantage of the warm days of the month to treat any cases of disease which he may have noted earlier in the spring. However, no hard-and-fast rule can be laid down in this matter, everything depending on locality and weather conditions. In some districts it would be almost suicidal for the beekeeper to treat his bees in October; in others, where right conditions prevail, it may be carried out with ease and safety, and the bees brought into good condition by the time a surplus may be expected. Wherever treatment has been undertaken the colonies should be watched in order to see that there is no danger of starvation, and where the spring flow is not considered heavy enough it should be supplemented by liberal feeding.

HIVING SWARMS.

In most text-books on beekeeping this kind of advice is given: "When a swarm settles into a cluster take a light box and shake the bees into it," &c. This advice is all right where the bees are accommodating enough to settle into a convenient position for the shaking process to be carried out. Unfortunately, in many cases bees get into positions whence it is impossible to dislodge them so easily. Sometimes they will settle on a small bush, and much of the cluster will be on the ground. In this case probably the best thing to do is to place the box over the cluster, and if the bees do not show much disposition to climb up into the box they may be persuaded to do so by the use of a little smoke. When they cluster in the centre of a prickly hedge the box should be placed on one side of the hedge, and the beekeeper should puff smoke from the other side of the hedge, and thereby drive the bees towards the box. In the event of the swarm taking possession of a fencing-post and clustering on it from top to bottom, as they occasionally do, the smoker must again be used, and in addition it is as well to brush the bees from each side of the post in turn into the swarm-box with the brush which is used for the frames at extracting-time.

The usual practice is to leave the box sheltered from the sun and covered with a sack near the place where the swarm has settled. Where few hives are kept this may be done with impunity, but if other swarms are expected it is well to remove the box to the place where the colony is to stand permanently, otherwise before the close of the day the probabilities are very largely in favour of the box being taken possession of by three or four other swarms—a matter of annoyance to the man who wishes to keep his swarms separate.

In every case a swarm should be attended to as soon as it settles. Many people are under the impression that swarms should be left undisturbed till nightfall, but this idea is an erroneous one. They should invariably be placed in the box as soon as possible after the cluster is formed, and put so that they are sheltered from the rays of the sun.

WATER-SUPPLY.

One of the most important of the minor details of apiculture is the provision of a constant water-supply for the purpose of assisting the bees in brood-rearing. Not only is it necessary to conserve the energy of the bees by having the water close at hand, but it is well to ensure that they do not prove a nuisance at taps, cattle troughs, &c. From early spring till late autumn water is an absolute necessity to bees, and they will consume comparatively immense quantities in fine weather. It thus behoves the beekeeper to see that a liberal supply is always available. By establishing his drinking-fountain early in the season he will teach the bees where to go for supplies, and ensure their always seeking the same spot for water.

—E. A. Earp, Senior Apiary Instructor.

THE GARDEN.

VEGETABLE-CULTURE.

In former notes it has been suggested that broccoli may very well be omitted in the warmest districts, cauliflowers being grown to take their place. The diamond-backed moth makes it difficult to grow broccoli in such places, as they must be planted when the moths are in full force. In other districts broccoli cannot be dispensed with. The moth is likely to cause some trouble in any locality, but the risk must be taken. In any case it will not be so serious a trouble as in warmer districts, mostly disappearing when autumn rains set in. The writer has been successful in preventing damage by the moth by giving the plants an early start, so as to secure good-sized plants before the moths become numerous—usually some little way into the New Year. With this object in view all the varieties to be grown should be sown at the same time—about the last week in October. The plants should be given every chance to make quick growth, and should be planted as soon as they are large enough. Good cultivation should be afforded, and a little nitrate of soda given to help them along. The plants should then be strong before the moths are troublesome, and if the latter do some damage to the outer leaves it will not matter if the growing centre is protected. This can be done by dropping a little hellebore powder on the heart of each plant. The hellebore will remain in position a long time. Rain will dissolve some of it and wash it farther in, but it takes a lot of rain to wash it out. Two or three applications at most will see the plants safely through. Early, mid-season, and late varieties should be grown, and though started together they will mature in the proper sequence.

Cauliflower of a giant kind should now be sown to give heads for use in autumn before broccoli come in. Brussels sprouts also should be sown, a long season of growth being necessary to obtain good crops.

French beans may be sown in all localities early in October, or somewhat earlier in extra-warm and frost-free places, where butter-beans may also be sown. For the cooler districts Canadian Wonder or varieties of the same type are best. Where broad beans were sown in June, or near that time, another sowing may be made in October, these two sowings being sufficient for the season. Runner beans should be sown early in October. To maintain a constant succession peas should be sown twice every month.

Lettuces should from now on be sown thinly in lines, the surplus seedlings being pulled out and plants for the crop left standing. Seeds for the main crop of leeks should be sown during the last half of September. Sow in lines and transplant when 8 in. or 9 in. high. In the colder districts winter crops of parsnips, carrots, and red beet should be sown in October, in middle districts during the first week in November, and two or three weeks later in the warmer parts. Turnips should be sown in small lots during the summer season, sowing a fresh lot about every seven weeks.

Increasing supplies of winter rhubarb on the market during the past winter show that the culture of this variety is extending. There is no doubt it can be made a profitable crop in all but the coldest districts. New beds may be formed by sowing seeds about the month of October, or by divisions of old stools. It is advisable to divide the old stools when they get too large, as the sticks are otherwise liable to come too small. A good time to lift the old stools is when the first crop of the summer variety comes into use. The stools should be cut up into pieces carrying one or two good crowns. All large leaves should be cut off, leaving only newly sprouting young leafstalks. Transplanting should be done at once on fresh ground previously prepared.

Success with onions largely depends on the attention given in the early stages. Timely thinning and thorough cultivation are important factors. A dressing of nitrate of soda, allowing about ¾ oz. per square yard (approximately 2 cwt. per acre), will have a marked effect on growth. The nitrate can be easily applied if mixed with dry wood-ashes.

Tomatoes.

In the warmest districts planting-out will have been already done, but in most places planting is not done till the end of October or early in November. The soil should be prepared a few weeks before planting. Where green crops are to be ploughed in, the green matter should be allowed time to get through the first stages of decay before planting is done. It is now a well-ascertained fact that the black-stripe disease, which has caused many losses, is mainly due to the excessive use of nitrogenous manures and fertilizers, including stable dung. The use of stable dung should be avoided. Suitable fertilizers are superphosphate, sulphate of potash, and sulphate of ammonia, allowing 3 oz. of the former and ¼ oz. of each of the others for each plant.

SMALL-FRUITS.

Raspberries: The disease known as raspberry anthracnose (*Gloeosporum venetum*) is fairly prevalent, and has caused the loss of crops. Correspondents have informed us that they have saved their crops by applying the remedies advised, where previously the crops were a total loss. The remedy is to spray with 4–4–40 bordeaux mixture when the young leaves begin to unfold, and again about a week before the blossoms begin to open. When the crop has been gathered the old canes should be cut out and the young canes sprayed as before. As an alternative spray lime-sulphur can be used, 1 in 10 for the first and 1 in 40 for subsequent applications. Bordeaux should have preference, as it has been proved to be effective. The disease first attacks the base of young canes, showing as purplish blotches on the canes. It gradually works its way up the cane. The blotches later assume a greyish colour, with a purple rim around them. It is in the second or fruit-bearing year that the damage is done. If the disease has been able to run its natural course it then attacks the fruit-bearing laterals and leaves thereon, and causes the fruit to shrivel up.

Gooseberries: If mildew is present, or the bushes are affected with leaf-spot, spray with 4–4–40 bordeaux as soon as the fruit is set.

—*W. H. Taylor, Horticulturist.*

New Zealand Meat-producers Board.—The electoral committee of the Board met at Wellington on 29th August. The three retiring producers' representatives—Messrs. J. C. N. Grigg, J. S. Jessep, and W. Perry—reoffered their services, and were unanimously elected. The committee also adopted the annual report and balance-sheet of the Board.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

HYDATID CYSTS IN CATTLE.

"SUBSCRIBER," Gisborne: —

Could you give me any information on hydatids in cattle, more especially as to what effect they would have on the milk of a cow?

The Live-stock Division :—

Hydatid cysts are the cystic stage of a tape-worm (*Taenia echinococcus*) of the dog, and are commonly found in the lungs, liver, and abdominal cavity of cattle, but may occur in almost any organ or tissue. The cyst takes six months to develop, and ranges in size from a pea to a duck-egg, or even larger. A liver or lung thus affected is more or less enlarged according to the size or number of cysts present. Symptoms vary in proportion to the seriousness of the infection. Where the lungs are badly infected there is marked alteration in the breathing; and in the case of the liver, digestion is disturbed and emaciation becomes marked. Diarrhœa is not uncommon. It is only in these cases that any marked alteration is noted in the quantity and quality of the milk, and though there would be no danger of hydatid infection from drinking it, this would be inadvisable, owing to the general ill health of the animal.

GRASS-MIXTURE FOR HILL-SLIPS.

G. H. WILLIAMS, Rakauroa :—

Will you please advise me as to the best grass to sow on hill-slips? They are of a sand-and-pumice nature, and soon dry up. Also, I notice you recommend the inclusion of danthonia in some of the mixtures given in the *Journal* for May last; as I believe there are various danthonias, which variety would you recommend as the best?

The Fields Division :—

If the land is not likely to be ploughed the following mixture is advised: Perennial rye-grass, 8 lb.; Waipu brown-top, 2 lb.; Chewings fescue, 4 lb.; Danthonia pilosa, 2 lb.; white clover, 1 lb.; suckling clover and Lotus major, ½ lb. each; Yorkshire fog, 3 lb. Sow at the rate of 25 lb. per acre. There are several varieties of danthonia; the pilosa variety should be used.

ABORTION AMONG EWES.

E. R. B., Swannanoa :—

I should be pleased if you would inform me the cause of a large percentage of my ewes in a flock of sixty slipping their lambs three weeks before due date of lambing. The ewes have had the run of a mixed-grass paddock, with as much oat-sheaf chaff as they could eat, and an occasional load of mangolds (pitted three or four weeks before using). In May last the ewes suffered from the flood, being a day and night in 20 in. of water, but have kept in good condition all through the winter. Would the abortion be caused by the chill of flood-water, or by eating the mangolds too readily? Believing the abortion to be contagious, I removed each ewe as the trouble commenced. Will the ewes breed again the following year?

The Live-stock Division :—

Contagious abortion in ewes is unknown in New Zealand, but ordinary abortion may be brought about by a variety of conditions, including excessive pressure on the pregnant uterus, such as over-distension of the rumen by

engorgement with chaff, fermentable mangolds, frosted turnips, &c. The use of old rams also may cause the slipping of lambs. The fact that your ewes were standing in 20 in. of water for a day and night would certainly be a contributing cause, owing to the chilling effect on the entire system and the struggling of the ewe. If mated, the ewes will breed again the following year.

CAUSTIC SODA FOR ORCHARD PESTS.

A. WILLIAMS, Wairere Falls :—

Could you let me know if you recommend caustic soda as a fungicide for fruit-trees? If so, at what strength is it used?

The Horticulture Division :—

Many years ago, before spraying practice was co-ordinated, caustic soda was used by a good many people to clear the trunks and large branches of fruit-trees from scale insects and moss and lichens. The soda was used with very little dilution and applied with a brush, the operator's hands being protected by leather gloves. Small branches and buds were protected against the scorching effect of the solution by the simple process of leaving them untreated. Later caustic-soda solution was used as a spray at strengths ranging up to 8 lb. to 50 gallons and stronger. This, while excellent for cleaning purposes, was rather severe on the operator as well as the spraying-gear, particularly the valves of the pump. In those early days of fruit-growing very little attention was paid to black-spot and kindred diseases. The fruit was affected or it was not, just as it happened. The great development in fruitgrowing rendered control of diseases and insect pests a necessity. This led to the use of more efficient and less crude methods—spraying-oils, lime-sulphur, &c., for insects, and sulphate of copper and lime-sulphur as the chief fungicides. At the present time, though one does occasionally hear of caustic soda being used, such use is not generally recommended.

"PEAS" IN COW'S TEATS.

KIRK BROS., Mokauiti, Taumarunui :—

Last May we dried off a three-year-old cow and turned her out for the winter quite sound, but with "peas" in all her teats. She has recently calved, and is blind in three quarters, evidently caused by the peas. Can anything be done for her, or to ensure her coming in sound next season?

The Live-stock Division :—

The complaint described by you is one of frequent occurrence, and is caused by inflammation of the teat-ducts, probably of an infectious nature. The obstructions can be removed or broken down, but the operation is not always successful. In spite of the most careful treatment, inflammation, with destruction of the quarter, frequently follows. On this account the operation is not to be recommended. If the obstruction is not interfered with the milk will gradually disappear from the quarter or quarters, and before the next calving-period, in many cases, it will be found that the obstruction in the teats has also disappeared.

COCKSFOOT FOR SEED-PRODUCTION.

"INTERESTED," Masterton :—

Last April I put down a paddock in cocksfoot for harvesting. Will you please inform me if it is advisable to harvest it next summer, or keep it fed down with stock until the following harvest season?

The Fields Division :—

It will not be wise to harvest your cocksfoot-paddock this coming season, as the cocksfoot will not be properly established by then. Treat it as a pasture-paddock this summer (but avoiding any heavy stocking), and harvesting operations can then be carried out the following season. Even then the yield will not be great, as it takes a cocksfoot stand some three or four years to come into full bearing.

WEATHER RECORDS: AUGUST, 1923.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE weather during August was changeable, and some very cold nights were experienced, but there was in most parts of the country more sunshine and less rainfall than is usually recorded in August. Three westerly disturbances occurred during the month. Two influenced weather conditions, each over four days, and one, in the middle of the month, accounted for unsettled conditions for about ten days. A strong southerly gale on the evening of the 20th and 21st was caused by an intensification of a disturbance centred in the neighbourhood of the Chatham Islands. Two ex-tropical disturbances passed to the north of New Zealand on the 10th and 24th respectively.

More snow than usual has been experienced during the past winter. There were some falls during August, particularly about the 20th, and the snow came low down the ranges in various places. The snow also has remained longer on the mountains than is customary.

Southerly winds were prevalent—cold and dry most of the time—and rainfalls were generally light.

RAINFALL FOR AUGUST, 1923, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Rainfall.
North Island.	Inches.		Inches.	Inches.
Kaitaia	4·44	14	1·02	5·10
Russell	4·41	16	0·86	6·99
Whangarei	5·17	15	1·33	6·93
Auckland	3·19	21	0·50	4·24
Hamilton	2·44	17	0·52	4·15
Kawhia	3·22	13	0·82	4·60
New Plymouth	3·20	13	1·24	5·38
Inglewood	4·90	11	1·20	8·82
Whangamomona	3·75	12	0·93	5·80
Tairua, Thames	4·92	11	1·56	6·98
Tauranga	3·21	14	0·64	4·21
Maraehako Station, Opotiki ..	2·90	12	1·98	4·75
Gisborne	7·07	20	1·73	4·50
Taupo	2·08	9	1·16	4·23
Napier	..	..	..	3·56
Maraekakaho Station, Hastings ..	2·93	14	0·81	3·40
Taihape	2·26	19	0·46	2·67
Masterton	3·62	14	0·98	3·26
Patea	1·62	10	0·46	3·57
Wanganui	1·48	6	0·39	2·78
Foxton	1·56	6	0·72	2·77
Wellington	3·45	15	0·85	4·44
South Island.				
Westport	4·01	15	0·88	6·27
Greymouth	7·20	13	1·81	7·87
Hokitika	6·62	13	1·40	9·38
Arthur's Pass	13·17	12	4·30	13·13
Okuru, Westland	7·66	12	2·40	11·46
Collingwood	5·24	8	1·25	6·96
Nelson	1·95	9	0·66	3·06
Spring Creek, Blenheim	1·65	7	0·40	2·86
Tophouse	3·79	11	1·28	4·87

RAINFALL FOR AUGUST, 1923—*continued*.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Rainfall.
South Island—continued.				
	Inches.		Inches.	Inches.
Hanmer Springs	1·92	7	0·50	2·23
Highfield, Waiau	1·42	8	0·40	1·90
Gore Bay	1·28	8	0·71	2·28
Christchurch	1·52	7	0·65	1·75
Timaru	0·48	5	0·18	1·48
Lambrook Station, Fairlie ..	0·74	3	0·64	1·53
Benmore Station, Omarama ..	0·98	8	0·35	1·50
Oamaru	0·54	4	0·24	1·76
Queenstown	3·61	10	0·86	1·80
Clyde	0·54	7	0·18	0·80
Dunedin	1·58	7	0·54	3·17
Gore	..	..	..	2·26
Invercargill	4·12	14	0·70	3·36

AMENDING CATTLE-TICK REGULATIONS.

THE following amending regulations were gazetted on 13th September current, and came into force on the same date. The principal regulations referred to were published in the *Journal* for March, 1922.

1. These regulations shall be read together with and be deemed part of the regulations (hereinafter termed the principal regulations) for the prevention of the spread of ticks (*Ixodidae*) among stock made under the Stock Act, 1908, by Order in Council on the 13th day of February, 1922, and gazetted on the 16th February, 1922.

2. Clause 7 of the principal regulations is hereby revoked, and the following substituted therefor:—

7. (1.) It shall be the duty of every stockowner in Area A to do all that is reasonably possible to keep his stock free from cattle-tick by (*a*) dipping by complete immersion in an effective cattle-tick-destroying solution, which shall contain not less than 7 lb. of arsenious oxide in each 400 gallons of water; or (*b*) treating by some other effective method authorized by the Inspector.

(2.) In any case where a stockowner fails to comply with the requirements of subsection (1) hereof to the satisfaction of the Inspector, that officer may give to such stockowner notice to dip or otherwise treat his stock so as to ensure the destruction of all cattle-ticks upon them, and it shall be the duty of such stockowner to comply with such notice within the time stated therein.

(3.) The provisions of subsections (1) and (2) hereof shall also apply in the case of stockowners in Area B upon whose property ticks have been found to be present.

3. Clause 10 of the principal regulations is hereby revoked.

4. Clause 12 of the principal regulations is hereby amended by the insertion of the figure "1" after the word "subclause" in line four.

5. (1.) Any person desiring to remove sheep from Area A must first obtain a permit from an Inspector, or some other person authorized by an Inspector, authorizing their removal, and such sheep may thereafter leave Area A only at the place and within the time specified in such permit.

(2.) If sheep intended to be removed from Area A are found to be harbouring ticks, a permit shall not be issued unless and until such sheep have been so treated as to ensure the complete destruction of all cattle-ticks upon the legs by immersion in an effective tick-destroying fluid, or by some other effective method at the discretion of the Inspector, or on the head by spraying or sponging with the same fluid; provided that the provisions of this subsection shall not operate where sheep are being removed for immediate slaughter at a duly licensed slaughtering-place.

DAIRY-PRODUCE EXPORT CONTROL ACT, 1923.

THE full text of this measure, as passed in the recent session of Parliament, is as follows :—

1. This Act may be cited as the Dairy-produce Export Control Act, 1923.

Act to be brought into Operation by Proclamation.

2. (1.) This Act shall come into operation on a date to be specified in that behalf by the Governor-General, by Proclamation approved in Executive Council.

(2.) A Proclamation shall not issue under this section unless and until a majority in number of the producers, within the meaning of this Act, have, at a poll to be taken for the purpose as herein provided, voted in favour of a proposal that this Act should be brought into operation.

(3.) At the poll to be taken as aforesaid proposals shall be submitted in the following form :—

1. I vote that the Act be brought into operation.
2. I vote that the Act be NOT brought into operation.

(4.) Every voter at the poll on the proposals submitted under this section shall be entitled to one vote only, and shall record his vote by striking out the proposal for which he does not wish to vote.

(5.) A proposal under this section shall be deemed to be carried if a majority of the valid votes recorded at the poll is in favour thereof, but not otherwise.

(6.) For the purposes of a poll under this section an officer of the Public Service shall be appointed as Returning Officer, and the Returning Officer shall make all necessary arrangements for the conduct of the poll.

(7.) The poll to be taken under this section shall be taken on a day or days to be appointed in that behalf by the Minister of Agriculture, being not later than the first day of November, nineteen hundred and twenty-three, and may be taken by post.

(8.) On the completion of the poll the Returning Officer shall make a declaration as to the result, and shall forward the same to the Minister of Agriculture, who shall cause notice of the same to be published in the *Gazette*.

(9.) The notice published in the *Gazette* shall be conclusive evidence of the result of the poll.

Interpretation.

3. In this Act, unless the context otherwise requires, "dairy-produce" means butter and cheese; "producers" means persons carrying on business as suppliers of milk or cream to factories manufacturing dairy-produce for export.

New Zealand Dairy-produce Control Board.

4. (1.) There is hereby established a Board to be known as the New Zealand Dairy-produce Control Board (hereinafter referred to as the Board).

(2.) The Board shall consist of—(*a.*) Two persons (herein referred to as Government representatives) to be appointed by the Governor-General, on the recommendation of the Minister of Agriculture, as representatives of the New Zealand Government; the Governor-General shall not appoint any person rejected by a vote of the producers as hereinafter provided. (*b.*) Nine persons (herein referred to as producers' representatives) to be appointed by the Governor-General as representatives of producers on election in manner hereinafter provided.

(3.) In addition to the members to be appointed pursuant to the last preceding subsection, the Governor-General may appoint one member as representative of persons for the time being engaged in business as manufacturers of dairy-produce, or as sellers of such produce out of New Zealand, whether as agents or on their own account. Such member shall be appointed for a term of three years, but may at any time be removed from office by the Governor-General, on the recommendation of the Board, or may from time to time be reappointed on the expiry of any term of appointment.

(4.) Of the producers' representatives six shall be elected in the prescribed manner by direct vote of the producers carrying on business in the North

Island, and three shall be similarly elected by producers carrying on business in the South Island.

(5.) Every person appointed as a Government representative under this section shall hold office during the pleasure of the Governor-General.

(6.) With respect to the first members appointed as producers' representatives the following provisions shall apply: (*a.*) Three of such members shall retire on the thirtieth day of June in each of the years nineteen hundred and twenty-five, nineteen hundred and twenty-six, and nineteen hundred and twenty-seven. (*b.*) The members so to retire in any year shall be determined by lot, save that in each of the said years two representatives from the North Island and one representative from the South Island shall retire. (*c.*) Any member retiring as aforesaid shall be eligible for reappointment to the Board.

(7.) Except as provided in the last preceding subsection, every person appointed as a producers' representative shall hold office for a period of three years from the date of his appointment, save that he may be reappointed in the manner prescribed by paragraph (*b*) of subsection two hereof, or may at any time be removed from office by the Governor-General, on the recommendation of the Board.

(8.) On the death, resignation, or removal from office of any member of the Board appointed as a producers' representative the Governor-General shall, on the recommendation of the Board, appoint some fit person to be a member of the Board for the residue of the term for which such first-mentioned person was appointed.

(9.) The powers hereinafter conferred on the Board shall not be affected by any vacancy in the membership thereof.

5. The Board shall be a body corporate, with perpetual succession and a common seal, and shall be capable of holding real and personal property, and of doing and suffering all that bodies corporate may do and suffer.

6. (1.) Any contract which, if made between private persons, must be by deed shall, if made by the Board, be in writing under the seal of the Board.

(2.) Any contract which, if made between private persons, must be in writing signed by the parties to be charged therewith shall, if made by the Board, be either under the seal of the Board or signed by two members of the Board on behalf of and by direction of the Board.

(3.) Any contract which, if made between private persons, may be made verbally without writing may be similarly made by or on behalf of the Board by any two members acting by direction of the Board, but no verbal contract shall be made for any sum exceeding twenty pounds.

7. (1.) In any case in which the Governor-General is satisfied that any member of the Board is incapacitated by illness, absence, or other sufficient cause from performing the duties of his office, the Governor-General, on the recommendation of the Minister of Agriculture if the member so incapacitated is a Government representative, or on the recommendation of the Board in any other case, may appoint some fit person to be named by the Minister or the Board, as the case may require, to be a deputy to act for that member during such incapacity; and any deputy shall, while he acts as such, have all the powers and authority of the member for whom he is so acting.

(2.) No such appointment of a deputy and no acts done by him as such shall in any proceedings be questioned on the ground that the occasion for his appointment had not arisen or had ceased.

8. (1.) The first meeting of the Board shall be held on a day to be appointed in that behalf by the Minister of Agriculture.

(2.) At the first meeting the Board shall appoint one of its members to be the Chairman of the Board.

(3.) On the second Wednesday in July, nineteen hundred and twenty-four, and on the same day in each succeeding year, the Board shall hold a meeting for the purpose of appointing a Chairman for the ensuing twelve months.

(4.) Any person appointed as the Chairman of the Board shall hold office until the appointment of his successor in accordance with this section, and shall be eligible for reappointment.

9. (1.) Except as provided in the last preceding section, meetings of the Board shall be held at such times and places as the Board shall from time to time appoint.

(2.) The Chairman of the Board, or any four members thereof, may at any time call a special meeting of the Board.

(3.) At all meetings of the Board five members (of whom at least one shall be a Government representative) shall form a quorum.

(4.) The Chairman shall preside at all meetings of the Board at which he is present.

(5.) In the event of the absence of the Chairman from any meeting of the Board the members present at such meeting shall appoint one of their number to be the chairman of the meeting.

(6.) At any meeting of the Board the Chairman shall have a deliberative vote, and in the case of an equality of votes shall also have a casting-vote, and a decision of the majority of the members present shall be the decision of the Board.

10. The Board may appoint such officers as it deems necessary for the efficient carrying-out of its functions under this Act.

London Agency of Board.

11. (1.) There is hereby also constituted an agency of the Board in London (hereinafter called the London Agency), which shall consist of such number of persons as the Board may decide from time to time, one of whom shall be appointed by the Governor-General, on the recommendation of the Minister of Agriculture, and shall hold office during his pleasure.

(2.) The other members of the London Agency shall be appointed by the Board, and shall hold office during the pleasure of the Board.

(3.) It shall be the duty of the London Agency to keep the Board advised as to current prices of dairy-produce, and as to other matters relative to the disposal of New Zealand dairy-produce in England or elsewhere, and generally to act as the agent of the Board in accordance with the directions of the Board.

Dairy-produce not to be exported save in accordance with Determination of Board.

12. For the purpose of enabling the Board effectively to control the export, sale, and distribution of New Zealand dairy-produce the Governor-General may, acting under the powers conferred on him by the Customs Act, 1913, and its amendments, prohibit the export from New Zealand of any dairy-produce save in accordance with a license to be issued by the Minister of Agriculture, subject to such conditions and restrictions as may be approved by the Board.

Board may assume Control of Dairy-produce intended for Export.

13. (1.) The Board is hereby empowered to determine from time to time the extent to which it is necessary, for the effective operation of this Act and the fulfilment of its purposes, that the Board should exercise control over the export of dairy-produce from New Zealand, and may assume control of any such dairy-produce accordingly.

(2.) In any such case the control of the Board shall operate as from a time to be specified in that behalf by the Board by notice given in conformity with this Act.

(3.) Notice by the Board of its intention to assume control of any dairy-produce may be given either by service on the owner of any dairy-produce or on any person having possession thereof, or by publication in any newspaper or newspapers, in accordance with such conditions as may be prescribed. Every such notice shall, subject to the provisions of this Act, have effect according to its tenor.

(4.) The control to be exercised by the Board over any dairy-produce may, as the Board in any case determines, be absolute or limited.

(5.) All dairy-produce of which the Board has assumed absolute control shall be shipped as the Board directs, and shall be sold and disposed of only by the Board, or by direction of the Board, at such times and in such manner and on such terms as the Board in its discretion determines.

(6.) Where the Board has assumed limited control the extent of its control shall be defined by notice as aforesaid, or by agreement between the Board and the owners of the dairy-produce or other persons having authority to enter into an agreement with the Board with respect to such dairy-produce.

(7.) Notwithstanding anything to the contrary in the foregoing provisions of this section, the Board shall not exercise its powers under this section with respect to the sale of any dairy-produce if the Board is satisfied—(*a*) That there is subsisting a contract for the purchase and sale of that dairy-produce made before the commencement of this Act, or (*b*) that there is subsisting a contract for the purchase and sale of that dairy-produce made after the commencement of this Act but before the Board has given notice of its intention to assume control of that dairy-produce, and that the dairy-produce to which any such contract as aforesaid relates is to be exported from New Zealand not later than the thirty-first day of August, nineteen hundred and twenty-four.

(8.) Notwithstanding anything to the contrary in the foregoing provisions of this section, the Board shall not exercise its powers under this section with respect to the sale of any dairy-produce so as prejudicially to affect the operation of any contract of agency in respect of the sale of dairy-produce out of New Zealand if such contract has been entered into in writing on or before the first day of July, nineteen hundred and twenty-three.

Contracts for Shipment of Dairy-produce.

14. (1.) After the constitution of the Board, or after such later date as the Board may by public notice appoint, no contract for the carriage by sea of any dairy-produce to be exported from New Zealand shall be made save by the Board acting as the agent of the owners of that dairy-produce or of other persons having authority to export the same, or in conformity with conditions to be approved by the Board: Provided that if the Board established under the Meat-export Control Act, 1921–22, by resolution notified to the Board under this Act, determines not to enter into any contract for the sea carriage of meat save in accordance with an arrangement between that Board and the Board under this Act, the Board under this Act shall not, while such resolution remains in force, have authority to enter into any contract for the sea carriage of dairy-produce save in accordance with an arrangement to be made with the Meat-producers Board.

(2.) Every contract for the carriage of dairy-produce by sea made otherwise than in conformity with this section shall be void.

(3.) Every person other than the Board who, after the constitution of the Board, or after such later date as aforesaid, exports any dairy-produce from New Zealand shall, on making entry therefor under the Customs Acts and before such entry has been passed, produce to the Collector or other officer of Customs sufficient evidence to satisfy him that the contract for the shipment of that dairy-produce has been approved by the Board.

(4.) The foregoing provisions of this section shall apply, with the necessary modifications, to contracts made before the constitution of the Board (whether before or after the commencement of this Act), save that the approval of the Board shall not be required for any such contract if the dairy-produce to which it relates is exported from New Zealand not later than the thirty-first day of August, nineteen hundred and twenty-four.

Levy on Dairy-produce exported from New Zealand.

15. (1.) There shall be paid by way of levy on all dairy-produce exported from New Zealand after a date to be fixed in that behalf by the Governor-General in Council, whether such dairy-produce is subject to the control of the Board or not, such charges as may from time to time be fixed by the Board, not exceeding the maximum charges that may be prescribed in that behalf by regulations under this Act (being not more in any case than one-eighth of a penny in respect of each pound of butter and one-sixteenth of a penny in respect of each pound of cheese exported as aforesaid).

(2.) All moneys payable under this section in respect of any dairy-produce shall be paid to the Collector of Customs on or before the entry of that dairy-produce for export, and shall be paid into the Consolidated Fund.

(3.) The net amounts paid into the Consolidated Fund as aforesaid, after deducting such proportion as may be prescribed in respect of the services of the Collectors and other officers of Customs, shall from time to time be paid to the Board without further appropriation than this section, and shall form part of the funds of the Board.

Particular Powers of Board.

16. (1.) Without limiting any authority specifically conferred on the Board with respect to any dairy-produce, the Board shall have full authority to make such arrangements and give such directions as it thinks proper for the following matters: (*a*) For the handling, pooling, and storage of dairy-produce; (*b*) for the shipment of such dairy-produce on such terms and in such quantities as it thinks fit; (*c*) for the sale and disposal of dairy-produce on such terms as it thinks advisable; (*d*) for the insurance against loss of any such dairy-produce either in New Zealand or in transit from New Zealand and until disposed of; and (*e*) generally for all such matters as are necessary for the due discharge of its functions in handling, distributing, and disposing of New Zealand dairy-produce.

(2.) For the purpose of securing any advances that may be made to the Board or to the owners of any dairy-produce at the request of the Board the Board shall, by virtue of this Act and without further authority, have full power on behalf of the owners to give security over such dairy-produce and to execute all mortgages and other instruments of assurance in the same manner in all respects as if the Board were the legal owners of such dairy-produce.

Application by Board of Moneys received by it.

17. All moneys received by the Board by way of levy under section fifteen hereof or in respect of the sale of dairy-produce or otherwise howsoever shall be paid by the Board into a separate account at a bank to be approved by the Minister of Finance, and shall be applied by the Board as follows: (*a*) In payment of the expenses, commission, and other charges incurred by the Board or for which the Board may become liable in the course of its business; (*b*) in payment of the salaries and wages of officers and servants of the Board; (*c*) in payment of travelling-allowances, fees, or other remuneration to members of the Board or of the London Agency (not being persons permanently employed in the service of the Government); (*d*) in payment of advances made by the Board to the owners of any dairy-produce on account of the price of that dairy-produce; (*e*) in payment into a reserve fund, from time to time as the Board in its discretion determines, of such amounts, not exceeding in any year the maximum amount levied for that year under section fifteen hereof, as the Board may consider necessary to enable it to carry on its operations under this Act; (*f*) in payment of the balance to the owners of dairy-produce controlled by the Board in proportions to be fixed by the Board by reference to the quantity and grade of the dairy-produce handled by the Board in respect of the several producers or other owners of dairy-produce.

Audit of Accounts.

18. The accounts of the Board shall be subject to audit in the same manner in all respects as if the moneys of the Board were public moneys within the meaning of the Public Revenues Act, 1910.

Liability of Board for its Acts or Omissions.

19. (1.) The Board in its corporate capacity shall in all its operations under this Act be deemed to be the agent of the owners of all dairy-produce of which the Board has assumed control; and the mutual rights, obligations, and liabilities of the Board and the several owners shall accordingly be determined in accordance with the law governing the relations between principals and agents, save that nothing herein shall be construed to limit the power of the Board to exercise, without the authority of the owner of any dairy-produce, any power with respect to such dairy-produce that may expressly or by implication be conferred on the Board by or by virtue of this Act.

(2.) The members of the Board shall not be personally liable for any act or default of the Board done or omitted to be done in good faith in the course of the operations of the Board.

Regulations.

20. For the purpose of enabling the Board to carry out its functions under this Act the Governor-General may make regulations prescribing the maximum charges to be paid by way of levy in respect of dairy-produce exported from New Zealand, and all such other regulations as he thinks necessary for the purpose of enabling this Act to be carried into effect.

FORTHCOMING AGRICULTURAL SHOWS.

Hawke's Bay A. and P. Society: Hastings, 17th and 18th October.
Poverty Bay A. and P. Association: Gisborne, 23rd and 24th October.
Marlborough A. and P. Association: Blenheim, 24th and 25th October.
Timaru A. and P. Association: Timaru, 24th and 25th October.
Wairarapa P. and A. Society: Carterton, 24th and 25th October.
Manawatu A. and P. Assn.: Palmerston North, 30th and 31st Oct. and 1st Nov.
Ashburton A. and P. Association: Ashburton, 31st October and 1st November.
Wanganui A. and P. Association: Wanganui, 7th and 8th November.
Canterbury A. and P. Association: Christchurch, 8th and 9th November.
Egmont A. and P. Association: Hawera, 14th and 15th November.
Waikato A. and P. Association: Hamilton, 20th and 21st November.
North Otago A. and P. Association: Oamaru, 21st and 22nd November.
Stratford A. and P. Association: Stratford, 21st and 22nd November.
South Otago A. and P. Association: Balclutha, 22nd and 23rd November.
Otago A. and P. Society: Dunedin, 28th and 29th November.
Southland A. and P. Association: Invercargill, 11th and 12th December.
Feilding I., A., and P. Association: Feilding, 5th and 6th February.
Clevedon A. and P. Association: Clevedon, 9th February.
Dannevirke A. and P. Association: Dannevirke, 13th and 14th February.
Taranaki Metropolitan Agricultural Society: New Plymouth, 5th and 6th March.
Waikato Central Agricultural Association: Cambridge, 5th and 6th March.
Methven A. and P. Association: Methven, 27th March.

(Agricultural and Pastoral Association secretaries are invited to supply dates and location of their shows.)

Rural Credit Associations Act.—Under the Finance Act, 1923, are repealed subsections (2), (3), (4), and (5) of section 6 of the Rural Credit Associations Act, 1922, the text of which was published in the *Journal* for December, 1922. Section 6 deals with the liability of members for the debts of the association, and the subsections now repealed made such debts a charge on the assets of the members, with priority over all other charges created after the incorporation of the association.

Presents of New Zealand Lamb.—In order to advertise New Zealand lamb, arrangements have been made by the New Zealand Meat-producers Board, through its London Office, to deliver single carcases of prime New Zealand lamb to any address in Great Britain for the sum of £1 13s. per carcase. All that is necessary is to remit that sum to the Secretary of the Meat-producers Board, P.O. Box 121, Wellington, together with the friend's full address.

British Market for Peas and Beans.—The following information was cabled by the High Commissioner, London, on 8th August: Peas—Prices for New Zealand partridge declined during the strike to 67s. 6d. per quarter c.i.f., but have recovered, and are now 77s. 6d. to 80s. ex store, though demand is slow. Tasmanian maple afloat are offered at 91s. Market is firm for blue. Prices of Japanese are affected by the earthquake, and have advanced 50s. to 90s. per ton; £20 per ton is asked for Tasmanian afloat; for good quality New Zealand near-at-hand shipments values are about £18. Beans—Market quiet. New Zealand nominally quoted at 50s. to 52s. per quarter, ex store.

Hubam Clover.—New-Zealand-grown seed of Hubam clover is obtainable from the Honey-producers' Association, Stanley Street, Auckland. The plant is an annual—not a biennial as stated in last month's *Journal*.

Moumahaki Ayrshires.—A good opportunity exists at present for private purchase of stock from the Ayrshire herd of the Moumahaki Experimental Farm, near Waverley, there being a few yearling heifers and bulls available.